BRIDGE SAFETY

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HEARINGS
BEFORE THE
SUBCOMMITTEE ON
INVESTIGATIONS AND OVERSIGHT
OF THE
COMMITTEE ON
PUBLIC WORKS AND TRANSPORTATION
HOUSE OF REPRESENTATIVES
ONE HUNDREDTH CONGRESS
FIRST SESSION

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BRIDGE SAFETY

TUESDAY, DECEMBER 1, 1987

House of Representatives,
Subcommittee on Investigations and Oversight,
Committee on Public Works and Transportation,
Washington, DC.

The subcommittee met, pursuant to call, at 10:05 a.m., in room 2167, Rayburn House Office Building, Hon. James L. Oberstar (chairman of the subcommittee) presiding.

Mr. Oberstar. The Subcommittee on Investigations and Oversight will come to order.

Today the subcommittee begins two days of hearings on the status of the National Bridge Inspection Program.

This program has been in existence since 1968, created in part in response to the serious questions raised about bridge safety after the tragic collapse of the now-famous, but infamously famous Silver Bridge across the Ohio River 20 years ago this month.

As we mark the anniversary of that tragic collapse and loss of life, we are again faced with questions about bridge safety across the United States.

In spite of the program, the condition of the Nation's bridges remains a serious problem.

The committee's interest in bridge safety is longstanding. It goes back to the very beginning of this subcommittee as the special investigating subcommittee on the Federal Aid Highway Program in 1959.

We have recognized the needs for adequate construction of bridges and adequate inspection of bridges, for the purposes of safety to assure the safe condition of bridges, since the very foundation of this subcommittee.

We are committed to assuring that these critical links, bridges in the Nation's transportation system, continue to be inspected and continue to be maintained in a thorough and timely manner.

If a bridge collapses, or if a bridge is allowed to deteriorate to the point where it cannot carry the load that it was intended to carry, its economic impact is widespread and its safety implications profoundly serious.

More than the cost of rehabilitating a bridge is involved. If you take away one short bridge span, you affect the miles of highway and the many communities that feed into and depend upon that bridge, that link to another area.

Effective management of the Nation's bridge inspection program, therefore, is critical to the Nation's economy. We are confronted with a system in which the average age of a bridge today is about 36 years.

The spurt of bridge building that took place in the fifties and sixties has resulted in a large number of bridges that are approaching the end of their life span and they require timely and thorough inspections.

There are an estimated 376,000 bridges open to traffic throughout the United States and of that number over 217,300 are Federal-aid Interstate, primary, secondary and urban bridges.

They carry 85 percent of the Nation's traffic, yet 76,000 of these bridges are deficient and that number has been gradually increasing over the last four years.

As we look at the problems with bridges over the past several years, it is difficult to say that there is a consistent pattern in bridge collapses, at least not a consistent pattern that can be traced to any particular style or design of bridge structure.

However, there are at least two bridge designs that have raised questions, the pin and hanger design used in the Mianus River Bridge and the design using spread footings, in which there are no pilings under the bridge support structure, as occurred in the New York Schoharie Creek Bridge.

We know there are elements of bridge design of particular concern to bridge inspectors; that is, bridges without redundant members to prevent a tragic collapse if that one critical member should fail.

We have to be very sure that bridge inspectors are very sensitive to the importance, are aware of and looking for fracture critical members, as they go about the inspection process.

Statistics tell us that flooding is the most frequent cause of bridge collapse. The Schoharie Creek Bridge collapse, for example, in April of this year, occurred during flood conditions.

We have to insure that inspection personnel are keenly aware of the problems involved with bridges whose supporting members are set in the floor of the body of water as compared to those that are set up on pilings driven into the subsoil and deeper.

In these two days of deliberations, we are hoping to find out how many of these types of bridges are in the Nation's bridge inventory. Right now that information appears to be scarce and perhaps in many states is not maintained at all.

We want to explore the attention paid by bridge inspection entities to the major causes of collapse, flooding, collision damage by boat or highway vehicle, traffic loads and weathering through age and corrosion.

Responsibility for oversight of the National Bridge Program on the part of the Executive Branch is in the hands of the Federal Highway Administration and on the part of the Congress, this subcommittee has that oversight responsibility.

Our task is not a simple one because there are no quick-fix answers to the problems that we face in bridge design, maintenance and inspection.

This hearing will focus on those problems and hopefully find solutions and develop proposals for resolving the problems in our Bridge Inspection Program.

Our staff has done a very thorough and careful job in preparing for these hearings. They have traveled throughout the country, interviewed representatives of State bridge inspection units in every region of the United States as well as related Federal Highway Administration State and regional offices.

Witnesses that come to the committee today and tomorrow will provide expert testimony on these important issues.

We will hear from the National Transportation Safety Board, the nation's watchdog on safety in all aspects of transportation.

We will hear from the Connecticut, New York and United States Departments of Transportation.

We will hear from the Center for Auto Safety, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and from a bridge consultant.

We look forward to a very intensive and continuing review of the Nation's Bridge Inspection Program.

[The statement of Mr. Oberstar follows:]

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

OPENING STATEMENT

CHAIRMAN JAMES L. OBERSTAR

HEARINGS ON BRIDGE SAFETY

DECEMBER 1, 1987

Today begins two days of hearings on the status of the national bridge inspection program, a program that has been in existence since 1968. In part, this program was created in response to the serious questions raised regarding bridge safety, after the tragic collapse of the Silver Bridge across the Ohio River in 1967. Now, as we mark the twentieth anniversary of that collapse, we are again faced with questions about bridge safety. In spite of the program, the condition of our nation's bridges remains a serious problem.

This Committee's interest in bridge safety is longstanding. It has recognized the seriousness of the problem as one that requires us to address not only the need for rehabilitation and repair but to also ensure that these critical links in our nation's transportation system are continued to be inspected and maintained in a thorough and timely manner. If a bridge collapses, or is allowed to deteriorate to a point that it cannot carry the load it was designed for, its economic impact is widespread. More than the cost of rehabilitating the bridge is involved. Take away one short bridge span and miles of highway feeding into it are affected.

Effective management of the nation's bridge inspection program is critical to the nation's economy. We are confronted with a system in which the average age of a bridge is about thirty-six years old. The spurt of bridge building in the 1950's and 1960's, has resulted in a large number of bridges approaching the end of their life span, requiring timely and thorough inspections.

Currently, there are about 576,000 bridges open to traffic. Of that number, over 271,300 are Federal-aid Interstate, primary, secondary and urban bridges. They carry 85% of the nation's traffic; 76,000 of these bridges are deficient; and that number has gradually increased over the last four years.

No consistent pattern in bridge collapses can be traced back to one type or style of bridge. However, there are at least two bridge designs that have raised questions - the pin and hanger design which was used in Connecticut's Mianus River bridge and the design using spread footings without pilings found in New York's Schoharie Creek bridge.

We know also that there are elements of bridge design that are of particular concern to bridge inspectors. Bridges with fracture critical members, that is, bridges without redundant members to prevent a tragic collapse if that one critical member should fail. We must be very sure that bridge inspectors are sensitized to the importance of fracture critical members in the inspection process.

Statistics tell us that flooding is the most frequent cause of bridge collapse. The Schoharie Creek bridge collapse, in April of this year, occurred during flooding conditions. Again, we must insure that inspection personnel are made keenly aware of the problems involved with bridges whose supporting members are set in the floor of the body of water, as opposed to those set on pilings driven into the subsoil.

In these two days of deliberations we hope to find out how many of these types of bridges are in the Bridge Inventory. We also want to explore the attention paid by bridge inspection entities to the major causes of collapse: flooding, collision damage by boat or highway vehicle, traffic loads and weathering through age and corrosion.

Responsibility for oversight of the national bridge program is in the hands of the Executive Branch, specifically the Federal Highway Administration. On the part of the Congress, this Subcommittee has the responsibility for oversight. Our task is not an easy one, there are no easy answers to the problems we face. This hearing will focus on these problems and the proposals made to resolve them.

The Subcommittee has been actively involved in these issues for the last five years. The staff has traveled and interviewed representatives of state bridge inspection units in every region of the continental United States, as well as the related Federal Highway Administration state and regional offices. The witnesses today and tomorrow will provide us with expert testimony on these important issues. They include representatives of the National Transportation Safety Board, the Connecticut, New York and U.S. Departments of Transportation, the Center for Auto Safety, the Federal Highway Administration, the American Association of State Highway and Transportation Officials and a bridge consultant.

Mr. OBERSTAR. The Chair wishes to express great appreciation to my colleague, Mr. Clinger, the gentleman from Pennsylvania, whose support for this hearing and understanding of the seriousness of its import has contributed greatly to the two days of hearings we are about to begin.

The Chair recognizes the gentleman from Pennsylvania.

Mr. CLINGER. Thank you, Mr. Chairman, for scheduling these hearings on what you have correctly identified as an extremely important issue, bridge safety and the adequacy of our National Bridge Inspection Program.

As a Representative from a Commonwealth with over 21,000 bridges listed in the National Bridge Inventory, I am obviously very interested in bridge safety and the functioning of our National Bridge Inspection Program.

The tragic consequences to human life and the economic dislocations that can result from weaknesses in that Program have been shown by the collapses of the Mianus River, Chickasawbogue and Schoharie Creek Bridges.

As you mentioned, Mr. Chairman, 20 years have passed since the Silver Bridge collapse first called attention to the need for a national program to identify and correct potentially unsafe bridges.

Since that time, millions of dollars have been poured into the inspection and highway bridge rehabilitation and replacement programs.

Despite the millions spent, close to 42 percent of the over 575,000 bridges listed in the NBI are rated as deficient. Unfortunately, this number is expected to grow as bridges built during the highway construction boom of the 1950s and 1960s age and develop problems.

While a deficient bridge is not per se unsafe, a deficiency rating indicates weaknesses or problems that should be monitored and corrected when warranted.

As the number of deficient structures grows and Federal and State budgets tighten, the need for proper maintenance and inspection of these important links in our transportation system becomes even more critical than it has in the past.

As you are aware, Mr. Chairman, I have been among the foremost proponents of creating new, fiscally responsive means of financing the billions of dollars needed to repair and expand all aspects of our Nation's crumbling infrastructure.

Part of that effort demands that we spend our money wisely. If the various elements of our infrastructure, like bridges, are not adequately maintained, we run the risk of spending scarce capital resources originally programmed for future needs in order to meet yesterday's neglect.

Today and tomorrow we will hear from witnesses involved in all aspects of bridge safety and inspection. We will learn about weaknesses in both the State programs and in Federal oversight of those programs as revealed by both NTSB's and our staff's rather extensive investigation of the inspection program.

We will also hear about FHWA's planned rule change and how FHWA plans to try to improve the inspection program over the next few years. Hopefully we will gain a better understanding of the practical problems involved in bridge inspection and what might be done to minimize the possibility of future bridge collapses.

I join you in welcoming the witnesses that will appear before us over the next two days and I look forward to hearing their testimony.

I thank the chairman.

Mr. OBERSTAR. I thank the gentleman for his comments.

The gentleman raised the matter of infrastructure financing, a matter that is not distant from the purpose of this hearing and the ability to pay for the facilities that keep our Nation productive is a matter of very great concern to the full Committee on Public Works and Transportation.

At the direction of Chairman Howard and with the support of Ranking Member Hammerschmidt, this subcommittee launched the first of a series of hearings on infrastructure financing.

The gentleman from Pennsylvania has been one of the innovative people in the Congress, in fact, the leader, I would say, in this matter of financing of infrastructure and we shall continue to pursue the matter of financing of the Nation's infrastructure, including our highway system.

Mr. OBERSTAR. Our first witness is Mr. James Burnett, Chairman of the National Transportation Safety Board, accompanied by Dr. Bernard Loeb, Deputy Director, Bureau of Accident Investigation; and Mr. Leslie D. Kampschror, Director, Bureau of Technology.

Gentlemen, welcome to the subcommittee hearings. Please raise your right hand.

[Witnesses sworn.]

Mr. OBERSTAR. Chairman Burnett, we welcome you to this hearing. I want to take this opportunity to compliment you and your very highly professional staff at the National Transportation Safety Board, for your work as the Nation's watchdog on transportation safety.

You have had a very busy year, I think it is appropriate to note that as we near the end of this year, at least the last month of this year.

Let's hope that you will not be as busy in these final four weeks of 1987. But your staff has been at work on the job. Promptly giving confidence to the traveling public, in whatever mode of transportation they travel, that action will be taken to discern the causes of transportation failures that result in loss of life or property damage. Providing recommendations, sound and sensible and reasonable ones, to correct the problems that result in such accidents.

You in the NTSB are a shining beacon in this area of safety.

TESTIMONY OF JIM BURNETT, CHAIRMAN, NATIONAL TRANSPORTATION SAFETY BOARD, ACCOMPANIED BY BERNARD S. LOEB, DEPUTY DIRECTOR, BUREAU OF ACCIDENT INVESTIGATION, NATIONAL TRANSPORTATION SAFETY BOARD

Mr. BURNETT. Thank you, Mr. Chairman.

We appreciate those kind remarks and appreciate the opportunity to be here with you this morning. The Safety Board is grateful for this committee's continued interest in improving bridge safety and inspection.

Before I begin my testimony, I would like to introduce Dr. Bernard S. Loeb, Deputy Director of the Board's Bureau of Accident Investigation.

Unfortunately, Mr. Kampschror cannot be with us due to illness.

Safety Board concern for bridge safety and inspection was brought into sharp focus following the sudden, shocking collapse of the bridge over the Ohio River between Point Pleasant, West Virginia, and Kanauga, Ohio, on December 15, 1967. The collapse took with it 31 vehicles, killing 46 people and injuring 9.

The Board determined that the probable cause of the collapse was a fracture caused by a flaw resulting from stress corrosion and corrosion fatigue. The Board noted that the flaw could not have been detected by any inspection method known at that time.

In view of the severity of the accident and the complexity of the issues involved, the Secretary of the Department of Transportation created a committee to examine the procedures, standards and criteria being used to provide for bridge safety throughout the country.

The committee, headed by the Chairman of the National Transportation Safety Board, also was tasked to make recommendations for improvements.

The result was the establishment of the National Bridge Inspection Standards which are the basis of current bridge inspection regulations.

More recently, the Safety Board has investigated and reported on two accidents involving major collapses of highway bridges—the collapse of the bridge carrying interstate 95 over the Mianus River in Greenwich, Connecticut, on June 28, 1983, and the collapse of the Chickasawbogue Bridge near Mobile, Alabama, on April 24, 1985.

In the Mianus investigation, the Board determined that the cause of the collapse was the lateral displacement of hangers by corrosion-induced forces due to deficiencies in the State of Connecticut's Bridge Safety Inspection and Bridge Maintenance Program.

The probable cause determined in the Chickasawbogue Bridge collapse was undetected deterioration of steel H-piles due to inadequate inspection of the underwater bridge elements by the State of Alabama.

Contributing to this accident was the failure of the Federal Highway Administration to adequately oversee the Bridge Inspection Program of Alabama in accordance with the National Bridge Inspection Standards.

Currently, the Board is investigating the collapse near Amsterdam, New York, of the New York State Thruway Bridge over the Schoharie Creek on April 5, 1987.

In this accident, the adequacy of bridge inspection is also of concern.

Although the probable cause has not yet been determined, there is evidence that there was less than adequate inspections, with no inspection of the underwater elements of the bridge since it was constructed.

Federal regulations currently require bridge inspections by the States at a minimum of every two years; the regulations also require the States to determine the type and depth of the inspections.

However, the States are not required to follow the guidelines or use the checklists. The Federal Highway Administration does perform an annual review of the States' inspection programs, but these reviews do not always uncover the weaknesses in these programs.

The Safety Board found in its investigation of the collapse of the Mianus River Bridge, and again in its investigation of the collapse of the Chickasawbogue Bridge, that the annual reviews of the State Bridge inspection programs performed by the Federal Highway Administration are essentially "paper audits."

Reviews by the Federal Highway Administration do little more than verify that State bridge inspection reports are completed and that all the boxes are checked.

The Federal Highway Administration personnel do make some field visits to observe bridge inspectors in action, but the frequency of such visits is not sufficient to observe the inspection of all types of bridges within the States.

The need for a proper audit of the compliance by States with the National Bridge Inspection Standards was pointed out in the Safety Board's report on the Mianus River Bridge collapse.

The Board concluded that a proper audit of the State's procedures should include, among other things, a careful review and evaluation of a significant sample of the bridge inspection reports, with special emphasis placed on reports on complex bridges.

A proper audit should also include a review of the number of hours spent on inspection of bridges, a review of the equipment used in inspection, a review of management policies and procedures, and a review of the inspector's training programs.

The Safety Board also concluded that a proper audit should include unannounced visits to bridge sites during regular inspections.

As this committee knows, the Federal Highway Administration published a notice of proposed rulemaking on April 7, 1987, on "National Bridge Inspection Standards; Frequency of Inspection and Inventory."

This NPRM proposes to lengthen the time between inspections, to modify the minimum requirements for supervisory inspection personnel and to require entering in State records with 90 days of inspection data on newly load-posted bridges.

On July 8, the Safety Board commented that, in the collapse of the bridges over the Mianus River and the Chickasawbogue Creek, the quality—that is, the extent and detail—of the inspections were of more concern to the Safety Board than their frequency, as these bridges had been inspected 9 months prior to and 21 one days prior to their respective collapses.

The Safety Board further commented that the NPRM was inappropriate in view of the unresolved issues related to the collapse of the Schoharie Creek Bridge and other bridge failures that have recently occurred in the Northeastern United States.

In fact, there are bridges with unique designs, older structures or harsh environments which may require inspections at intervals of less than two years to provide for adequate public safety.

For example, bridges over water probably should be thoroughly inspected after each significant flood.

The Federal Highway Administration and the AASHTO have long recognized that a shorter inspection cycle may be necessary for bridges which have unique design features.

Further, apparently not all States accept the Federal Highway *Administration's current two-year cycle as adequate,* as some States require a one-year cycle for inspections of some or all of their bridges. This NPRM does not adequately address these points.

Investigation of the collapse of the Chickasawbogue Bridge revealed that many States were not performing underwater inspections of their bridges.

In fact, I think 35 States did not have comprehensive programs to do that. Further, the inspections performed by some of those States doing underwater inspections were not sufficiently thorough.

In April of 1986, about a year before the collapse of the Schoharie Creek Bridge and the issuance of the NPRM, a Federal Highway Administration Associate Administrator wrote to each regional administrator that "each regional office should provide appropriate leadership and direction to division offices to ensure that States have developed and are carrying out a soundly based underwater inspection program."

Federal Highway Administration divisions then required each State, as part of its Bridge Inspection Program, to have written criteria specifying the conditions under which underwater inspections are necessary, the bridges needing such inspections and the frequency of such inspections.

Unfortunately, there was no requirement that such inspections had to be done within a specific time, although the Federal Highway Administration did refer to the AASHTO Manual for maintenance inspection of bridges which recommends a maximum of five years between underwater inspections.

As a result of the Chickasawbogue accident, the Safety Board, in April 1986, recommended that the Federal Highway Administration establish criteria for the inspection of the underwater elements of bridges based on factors such as the complexity of the structure and the materials used, the Marine environment and the frequency and magnitude of the loads on the bridge.

The NPRM issued in April does propose that States identify and maintain a master list of bridges, which have underwater members which cannot be visually evaluated during low tide or by feel.

The NPRM proposes that underwater members must be described and the inspection procedures must be stated.

The NPRM also proposes that the inspection frequency not exceed five years. However, the NPRM does not adequately respond to the recommendation for the establishment of criteria for the underwater inspection.

The Safety Board has been unable to learn from FHWA or AASHTO how many bridges there are in the United States with spread footing like the Schohari Creek Bridge, because the data needed to determine this is not requested on the SI&A report form.

However, it has been reported to the Safety Board that the State of Virginia alone has more than 400 such bridges. One of these Virginia bridges collapsed during a flood on September 7, 1987.

The Safety Board is concerned about the collapse of three major bridges, and numerous lesser bridges, in less than four years.

We believe that these collapses suggest that the current Bridge Inspection Program, including the oversight of State inspection programs by the Federal Highway Administration, needs improvement.

We further believe that great care must be exercised before permitting any increase in the interval between inspections of bridges.

In the interest of time, Mr. Chairman, I will conclude my summary and respond to questions.

Mr. OBERSTAR. Thank you very much Chairman Burnett, for that presentation, for your summary. The full statement will appear in the record as submitted to the committee.

There is much valuable detail in the balance of your statement, which I have read very carefully, and I think it is important for us to have all of that in the record and I will refer to some of those points.

What came through in your testimony and in the investigations, that the Board has conducted following bridge collapses, is a pattern of problems that seem common to a number of bridge collapses.

One of those is training of inspectors. Another, that you cite later in your testimony, is inadequate training of divers who do underwater inspections and paper audits, paper audits that agencies, Federal and State, attempt to substitute for hands on inspection.

That is the first point that I would like to discuss with you.

There is a pattern in safety—in aviation, in pipelines, in bridges—of relegating to paper audits the real important work of safety inspection that should be done in hands on fashion.

Now, this subcommittee has looked at all three of these areas. Two-and-a-half years ago we heard testimony from the Federal Aviation Administration's Miami Flight Standards District Office, we are so shorthanded we are inspecting paper work, not engine work.

We are not doing the aircraft fuselage inspection that we should be doing. We are looking at paperwork. We heard last year in the wake of the Moundsview pipeline failure, which the Board has investigated, that the Office of Pipeline Safety was doing paper audits.

In fact, in this case they hadn't done an inspection in five years. A problem existed that the company was aware of, lack of cathodic protection for that pipeline, that did not turn up in the paperwork and the agency itself admitted that if there had been more frequent hands on inspections, even a more frequent review of the paperwork, that accident could have been prevented.

At least the problem would have been caught and somebody could have gone out to do a personal inspection.

Now we see, in the case of bridges, relegating to paper audits the important work of looking at the factors involved in safety.

There is some—perhaps some sort of a gray area of efficiency where some work must be done and can reliably be done through inspecting the paperwork. Where does that line end, where in the Board's experience must you cut off the paperwork and get people into the field and at what frequency?

Mr. **Burnett.** I think there has to be enough spotchecking that you can confirm the accuracy of the paper that you are looking at. A paper can be as misleading as it can be informative and if there is no program for spotchecking, you don't know what you are dealing with.

In several of the Board's investigations we have cited the need to have some federal presence on a random and unannounced basis to look at some of the inspection programs as they were being conducted and to see that the paper was being filled out after adequate inspections.

Of course, you can't do that on all of them because then in effect you would have the Federal Government doing all the inspection and that is not the system that we have tried to design. But certainly you can't rely on the other end where you have no confirmatory information on the field activity.

Mr. **Oberstar.** In the case of pipelines, two years is sort of the outside maximum time within which inspections should be done, one-year inspections would be preferable.

You are aware of the proposed flexible schedule of bridge inspection the Federal Highway Administration is proposing in place of the current two-year frequency.

What problems do you foresee? Are there some types of bridges, are there some climatic conditions in the country, where there needs to be a rigid time frame established instead of this flexible approach the Federal Highway Administration is taking?

Mr. **Burnett.** I am not opposed to a flexible approach, in fact, that is what the Safety Board has been advocating. There are many bridges in this country that do not need to be inspected every two years and we should not waste our resources.

There are many others that need to be inspected that often or more frequently including those subject to environmental hazards such as brackish water, to flooding conditions to other extremes of environment that are very complex bridges, bridges without the redundancy that you find in other bridge designs. All these factors have to be considered.

I think the problem that the Safety Board has with the FHWA proposal is that it basically allows the States to abandon the two-year requirement to develop their own standards as to what frequency should be imposed to submit this to the Federal Government without any assurance that we are going to have the kind of rigorous analysis to be sure that this does not represent a derogation in the Bridge Inspection Program.

It is not that we disagree with the policy of flexibility. It is that we are not convinced that we will have a rigorous analysis of the flexibility the States come up with. And I think, given the need to do that for the 50 State proposals, and actually there are more highway programs than we have States, I suppose, it might be better for the FHWA to do its own analysis and develop its own standards and it might be less demanding than it would be to try to review and make individual decisions on evaluating the State plans.

Dr. **Loeb.** We have asked the Federal Highway Administration to undertake research to determine what factors the frequency of inspections should be predicated on. Federal Highway has informed us in the past that this research would be undertaken.

To date we don't see the results and in fact I have been informed that the research hasn't been started, but we think that research needs to be done before decisions could be made with regard to critical issues in this NPRM.

Mr. **Oberstar**. That is a matter we will take up with Federal Highway Administration. I agree about the need to concentrate resources. We know that we have fiscal restraints and that resources must be concentrated on the obvious problems areas and those of historical concern. That is as true in pipeline safety as it is in aviation safety and applies clearly here as well.

But speaking of concentrating resources, statistics show that the Northeastern region of the United States has probably the greatest number of deficient bridges principally because of age.

Most of those were built in earlier times because of that concentration of population in that area of the country, with heavier traffic, harsh winters and de-icing.

I come from an area of the country where salt or salt substitutes are used very heavily and have very corrosive effects upon the highway surface and especially on bridge surfaces.

Should there be a different standard for those areas of the country and for regions that have less demanding climatic conditions?

Mr. **Burnett**. I think climatic conditions should be examined. The particular applicant of climatic conditions is not totally limited to the Northeast. In fact, we find some of the corrosive problems with bridges to be in the Southeast where you tend to have brackish water and some changes in temperatures and it creates corrosion circumstances.

In fact, I think one of the reasons that we probably have better developed underwater inspection programs in some of the Southeastern states is because of that. But certainly across the country, the climatic conditions that the bridges are exposed to should be considered in establishing the inspection intervals.

Mr. **Oberstar**. I certainly agree about the brackish water areas of the country. They have their own particular kind of problems, those that are exposed to salt air have heavy corrosion problems. I have taken the time and trouble myself to look at technology in the anti-corrosion area, and find that there are a number of developments that can improve our highway construction practices—and the subcommittee will hold a hearing on that subject at some future, yet to be announced date, after we have had further inquiry into the subject. I think that is a very, very important area for us to focus on.

Training of inspectors—we saw that as a problem in aviation safety. We see it as a problem in pipeline safety. It has shown up in the Board's investigation of State highway programs and bridge collapses.

Has the Federal Highway Administration responded to the Board's recommendations to improve and modify inspection and training manuals, and have they followed through on that recommendation and made those changes to your satisfaction?

Dr. **Loeb**. They have made a change, or are in the process of further changes, I understand. They have changed and improved the inspection and training manuals, and I think in that area they have been responsive to the Board's recommendations. However, in other areas, such as requiring certain actions on the parts of the States, we are not yet satisfied.

Mr. **Oberstar**. It is one thing to then change the manuals; it is another thing to actually do the training.

Has the Board any information to share with the subcommittee on actual training programs and their effectiveness?

Mr. **Burnett**. Well, we are really not in a position to evaluate that closely. I think we will have a little more insight into it as we complete the Schoharie Bridge investigation as to what actually is being done.

We do know that the Federal Highway Administration has taken steps in that area. Whether or not we have gone as far as we need to go, I think is doubtful, but we will have to take a further look at that.

Mr. **Oberstar**. In the latter part of your testimony there is a discrepancy in view between the board and the Federal Highway Administration, as to who should do underwater inspections. Is it correct to have a diver do underwater inspections, or should that person have training as an engineer?

In the absence of engineering training, what preparation is there for a diver who is going to be doing underwater inspections?

Are you satisfied that the Federal Highway Administration is doing things to adequately address that concern?

Mr. **Burnett**. No, we are not satisfied. A diver who is well trained and who is working in close coordination with a team, using an engineer, and committed to this purpose, can carry this out quite well.

However, if you just go out and hire a diver to go down on a onetime basis, who is not trained to do that, and come back and report to an engineer, that is probably not an adequate approach.

The team approach, using a diver and a trained engineer who work together repeatedly, I think, is something that probably is very realistic with appropriate training.

Mr. **Oberstar**. Thank you.

The Chair will have further questions later.

The Chair recognizes the gentleman from Pennsylvania, Mr. Clinger.

Mr. **Clinger**. Thank you very much, Mr. Chairman.

Thank you, Mr. Burnett and Dr. Loeb, for your testimony.

Do Federal bridge inspectors have primary responsibility for inspections of Federal-aid bridges, or is their role primarily an oversight function to double check state inspectors?

Mr. **Burnett**. Actually it is an oversight function. That is the conception of the law that the states would do the inspections and the Federal Government would oversee to make sure the inspections are being done. That is one of the many federal programs that promised the public a lot more than it is delivering, in the sense that we have manifestly inadequate inspection programs in a great many states, and it doesn't take a great deal of perception to see that.

For instance, there are many bridges that have critical underwater elements, and many states were going for years—as in the case of the Schoharie Bridge, for the lifetime of that bridge, without inspecting the underwater elements.

Those are pretty obvious factors where the goals of the national bridge inspection standards have really not been met. We were talking about the training, the necessity for improved training.

Mr. CLINGER. Do you feel that Federal inspectors, those who are conducting the oversight functions are adequately trained?

Mr. BURNETT. I tend to think that the problem is that they have inadequate resources to do the kind of probe we would like for them to do.

Mr. CLINGER. That is in terms of numbers of inspectors?

Mr. BURNETT. I think so, and therefore you have to compromise. They are in a position where, regardless of their competence, they have to rely on a system that doesn't permit them to get into the nitty-gritty.

The resource question has to be addressed before we can tackle confidence. I am sure there are highly qualified people doing that work.

Dr. LOEB. One of the problems is that in addition to inadequate numbers, the bigger problem is that there are inadequate numbers of the kinds of disciplines that are needed, for example, specialists in structures.

There may be in a division office only one structural specialist, and that specialist may be engaged in a number of things other than just looking at the structural review of the inspection of bridges.

Mr. BURNETT. I think underlying it all is that the policy decision behind this has been not to have an aggressive program and——

Mr. CLINGER. As the Chairman indicated, a lot of what is done in oversight functions is accomplished by reviewing paper and not by going out in the field looking at the bridges which are being certified to as safe.

You mentioned that you think there should be a more aggressive use of unannounced spot checks of inspected bridges. I gather you are saying that most of the time the state or local people are aware of when a Federal inspector is going to come in and view their work?

Mr. BURNETT. I doubt they are very often aware, because I don't think it happens——

Dr. LOEB. They are aware on many occasions, but the problem is that direct inspection, oversight of the inspector during the activity of the inspection is a rare event.

Mr. CLINGER. Assuming that we institute a more aggressive, vigorous spot inspection, what leverage does the FHWA have to do if they find that an inspection program is deficient?

Mr. BURNETT. There are sanctions incorporated into the act. I think the Federal Highway Administration would be able to——

Mr. CLINGER. Withhold funds?

Mr. BURNETT. I think it would be proper for them to comment on what their sanctions and options are because we have not gotten into that stage of it. We have asked them to increase their enforcement, the level of their surveillance, and I think they have done that in response to our recommendations.

As far as I know, I have not heard that they don't have adequate sanctions available to them. The sanctions may be too gross in the sense that they are so—they have such great impact that nobody wants to consider it a realistic matter of using them.

Mr. **Clinger.** As I indicated in my opening statement, Pennsylvania has the second highest number of bridges in the country, next to Texas. A lot of those bridges are county, city, borough, township bridges, as are an awful lot of bridges across the country. My concern is whether we are getting down to that level in terms of the bridge inspection program or is the main emphasis on the federal-aid system bridges? How do we ensure that inspectors are really getting down to where some of the major problems may be, because those bridges often get overlooked?

Mr. **Burnett.** I think that is one of the places where the Safety Board, in that we investigate major bridge collapses, is not in a good position to enlighten the committee on exactly what is happening with the small bridges.

As I have pointed out, I think it would be unfortunate to try to place on all the 21,000 bridges in Pennsylvania a requirement that you have to inspect every one of them every other year, because many of those don't require that, although some of the older ones may, even of the smaller and less complex bridges, especially where you know you have a problem with a bridge, and in order to keep close tabs on a problem that might develop faster than it is expected to.

Mr. **Clinger.** I know that within the last two years in my congressional district there has been loss of life because of bridges washing out but it was not a major front page story. The Pittsburgh Post has had nothing that would really catch the attention, I suspect, of anybody down here, but lives are lost nonetheless because a bridge washed away. I am just concerned that we may not be reaching that level of minutia if you will, in terms of our inspection program.

Just to conclude my opening set here, you did mention, Chairman Burnett, that there have been three major bridge collapses in the past four years. You also talked about the fact that significant numbers of bridges that were built in the 50's and 60's are now reaching a point of age where they really deserve to get serious attention and inspection.

As things currently stand with the inspection program, with no changes in the way it is presently organized, can we expect to see an increase in the incidence of bridge collapses over the next few years unless we do make some changes in the inspection program?

Mr. **Burnett.** I am afraid that is true.

Mr. **Clinger.** Thank you, Mr. Chairman.

Mr. **Oberstar.** The Chair recognizes the gentlewoman from Connecticut, who has been a leader in the Committee's efforts to encourage stronger and more effective bridge inspection programs, largely because of a problem very close to home.

Mrs. **Johnson.** Thank you, Mr. Chairman.

Welcome, Mr. Burnett. It is good to have you here today.

You mentioned in your testimony that more research is needed. In my mind I am connecting that with those portions of your testimony which talk about the reasonableness of differentiating between certain types of bridges so that we will have the ability to better target our limited resources.

Your testimony also provided a very rough estimate, and I realize you are not proposing this as a soundly-based estimate of the savings, but you estimate that something on the order of $8 million might be better deployed if we were able to identify those bridges that need more frequent inspections from those that require less.

From your testimony my assumption is that there is research that needs to be done to better understand which kinds of structures need less attention. I assume also that you are proposing, in a sense, a national inventory which would be consistent from State-to-State, identifying bridges in various categories, so that we would have, both State-by-State and nationally, a sense of how many bridges of certain types there are and which ones don't need as much attention, and so on.

Do you think we need that kind of research and if so, what are the dimensions that are needed?

Mr. BURNETT. Let me first address the comment about the $8.4 million I believe that we quoted from the Federal Highway Administration, and I think the Board does not want to adopt—we don't want to be understood as adopting that figure.

I think we mentioned it in our testimony with skepticism, that it was based on assumptions that we don't know from whence they are derived. Undoubtedly there could be some savings by extending the interval between bridge inspections for certain types of bridges, and that is a desirable goal, but we have not yet seen the research that gives us a basis for doing that, for drawing a distinction between different bridges.

We understand from the Federal Highway Administration that that is ongoing, but we have not seen the results of it. We need to have the same sort of attention addressed to the five year underwater inspection interval. The AASHTO guidelines say that every bridge should be inspected once every five years for its underwater elements.

Right now I suppose most bridges with underwater elements in the country are not being inspected but only recently have begun to be. So that is a step in the right direction, but may yet be inadequate. We need to have a shorter period of time for many bridges in the country and we need to identify those.

Mrs. JOHNSON. I hope that this panel will pursue the topic of research tomorrow with FHWA. I would hope that research would look into the categorizing bridges and would not categorize them only as to structure type, but also would categorize them based on conditions.

Mr. BURNETT. That is clearly our aim. It should integrate structure, the environmental conditions they have, if they have known problems, that may need to be monitored that should be the basis or advanced schedule.

Mrs. JOHNSON. But what I hear you saying is that it is reasonable to assume that we could do the research and describe our bridges in such a way that we could responsibly focus our limited resources on those areas where we are likely to have more serious problems.

Mr. **Burnett**. I definitely think so. I think it is a necessity that we do so.

Mrs. **Johnson**. I think it is a necessity too. That is why I wanted to be sure that you felt that is where we ought to be heading.

Second, do your people, when the NTSB investigates a failure, conduct confirmatory inspections to evaluate the quality of the inspections conducted on bridges that collapsed?

Mr. **Burnett**. We are really not staffed to do that. In fact, it strains us to do the investigations that we have. They are very complex investigations. But to go out and try ourselves to do what we believe the Federal Highway Administration should do, apparently is not really staffed to do, would be impossible.

Dr. **Loeb**. I might add, we do of course review the inspection records in detail. We also talk to the inspectors to determine what they have done. Of course, at the time we investigate a bridge collapse, a complete evaluation of all parts of the bridge can no longer be done, as we all appreciate. But in the process of doing the investigation, we obviously observe the condition of those parts of the bridge not destroyed. So we physically determine in many cases whether certain inspections have been done recently and check that with the paperwork that exists on the inspections.

Mrs. **Johnson**. Actually, some of those paper reviews that you do, you do in very, very great depth. They can provide you with a lot of information. That is my conclusion from what you said.

Mr. **Burnett**. Yes, in many cases we found the thing that stands out about them is the absence of information that should be included on the forms that is not there.

Mrs. **Johnson**. So as part of your recommendation urging reform of the program, you would want to see the inspection forms changed?

Mr. **Burnett**. We have made recommendations for improvements in the form. I think many of those have been adopted.

Dr. **Loeb**. We have been told by the Federal Highway Administration that they have revised the SI&A form. We have not seen the revision. We have been told that a number of revisions we have asked for in our recommendations have indeed been implemented. But the revised forms are still just that. They are in a prototype stage and have not gotten out into the field yet.

Mrs. **Johnson**. Thank you.

And lastly, how many states use a team approach, a team of the caliber that you are recommending?

Mr. **Burnett**. I don't think we have an update on that. We are talking about, in relation to underwater activities and when we did our Chickasawbogue Creek investigation, there were only 15 States that had underwater inspection programs, and I am not sure how many of those actually use a team approach.

Dr. **Loeb**. We do know there are some, but we don't have a count. I can't give you an accurate count.

Mr. **Burnett**. Hopefully that has increased since that time.

Mrs. **Johnson**. Hopefully.

Thank you very much for your testimony.

Mr. **Oberstar**. One of the points that stands out for me in your testimony is that quality of inspection may be more important than frequency of inspection. Quality of inspection you define in terms of extent of that inspection and the amount of detail involved in the inspection itself.

I would tend to agree with that. I think that makes very, very good sense.

You cite two instances of bridge collapses in Alabama and New York in which there was an inspection prior to, very close to the time of the collapse of the bridge, but apparently the inspection was not thorough enough, not detailed enough, and did not pick up the problems that led to the collapse of the bridge.

We have seen that also in aviation, inadequate detail and thoroughness of inspection. We have seen it in the pipeline field. Does the proposed rulemaking address that essential elements of extent, detail and quality of inspection?

Mr. **Burnett**. No, that is a disappointing thing about the NPRM pending. The Federal Highway Administration has indicated to us that they were going to address the quality of inspections issue as part of this NPRM, and we do not think that that was adequately addressed. We are more concerned about that than we are about the frequency of inspection issue.

Mr. **Oberstar**. Has the board submitted recommendations addressing the issue of quality of inspection that should be included in the NPRM?

Mr. **Burnett**. Yes sir. Of course, most pointedly in the area of need for underwater inspections. If you have critical structural elements underwater and you don't do an underwater inspection, how can you say you inspected the bridge?

And we have made the point that when you have inspections for load posting requirements, and you don't look at the underwater elements, how can you know what the load posting limitations should be?

But even beyond that, as we saw in the Mianus bridge case, there is a need, especially on complex bridges, to have definition of how far you need to go and what kind of studies you need to meet.

Mr. **Oberstar**. Would you submit to the subcommittee the board's specific recommendations on those points—quality of inspection? We would like to have that included in the record, and we also would like to raise those matters with the Federal Highway Administration tomorrow.

Dr. **Loeb**. Could I add we have specifically made recommendations regarding the extent of the criteria? That is the Federal Highway Administration established criteria, guidelines, the extent to which these inspections should be done. We were informed by the Federal Highway Administration that the NPRM would include that kind of requirement, and we do not see it in the NPRM. So right now we believe that those specific recommendations are not being addressed.

Mr. **Oberstar**. You also address the matter of inspection of tension type bridges or inspection of tension conditions, bridges over water, bridges in harsh environments, whether it is cold weather in the North or salt air in the coastal regions, older structures, unique designs, inspection after major weather events—floods, earthquakes. Does the NPRM adequately address the Board's concerns about those categories of bridges?

Mr. **Burnett**. No.

Mr. **Oberstar**. What should be done? What should that NPRM include to address the Board's concerns?

Mr. **Burnett**. We had hoped to see some requirement for inspection investigations following earthquakes, following flooding of bridges.

Dr. **Loeb**. It does address the requirement for the states to specifically identify and list and put into the record those bridges that have fractured critical members or those bridges that have underwater members that cannot be examined at low tide or by feel. Our problem with it is that the NPRM leaves to the states the decision as to how to inspect these bridges in the development of an inspection program.

We believe that the Federal Highway Administration has to do some of that work and give the states guidelines on the best ways to do that.

Mr. **Oberstar**. I would fully agree with that. I am frankly very, very surprised that the first major effort to improve bridge inspection programs does not address the concerns the Board has set forth. That is a very great concern to me.

In those areas of the country that are earthquake prone, do the states there have adequate inspection programs for followup after an earthquake event?

Mr. **Burnett**. I am not sure exactly which areas of the country we would say are earthquake prone. It has been a long time since we have had a damaging earthquake in my home state of Arkansas—back in 1912 or 18 something. 1814, something like that. There was one that changed the course of the Mississippi River. So I don't know. I suppose all of the states in that area might be considered earthquake prone. I don't want to point fingers at California.

Mr. **Oberstar**. The Board has not then undertaken a comprehensive review of the states in those areas?

Mr. **Burnett**. No.

Mr. **Oberstar**. Is that something that the Federal Highway Administration should be addressing?

Mr. **Burnett**. We believe it should.

Mr. **Oberstar**. Those bridges that you address in your testimony that may not require two-year inspections, those that have standard designs, that is, that are multi-redundant bridges, those that are over land or over railroad passages, you still say they should have two comprehensive inspections within a two-year period before they should be certified for longer inspection cycles?

Mr. **Burnett**. That is our position, although we recognize many bridges do not need to be inspected every two years, it is important that we have, I think at least two inspections within a one or two years period to find out what the trends are on those bridges before we can say we are safe in letting this one go for five years, or whatever period is selected. And I don't have enough confidence in the bridge inspection program across the nation to say we have that right now, that we really have identified those that may be of concern.

Mr. **Oberstar**. Does the NPRM address that matter adequately?

Dr. Loeb. No.

Mr. OBERSTAR. Well then, from the standpoint of concentrating resources that we discussed earlier, it seems to be reasonable that the NPRM should address that category of bridges and that these inspections within a two-year period—should be careful, detailed, high quality inspections. You can then have a longer period in between to concentrate efforts on other bridges that are more critical or more in need of more frequent, more detailed followup?

Dr. LOEB. I think what the NPRM does is basically leave it to the states to draw up these criteria. From the standpoint again of the Federal Government, if we are really going to have a rigorous analysis of each program that each state comes in with, it seems that is going to be more resource draining than it would be for us to do the job right in one basic package to begin with. Maybe some of the states won't seek this option. I really rather doubt that is going to be the case.

Mr. OBERSTAR. I am concerned about that factor at this point because here we are at the outset of starting a whole new cycle of bridge inspection initiatives, and it isn't going to be done as thoroughly, at least it appears, as the Board would like to see it done.

You know, and I know, from our experience in safety, that it is those instances, those examples that fall through the cracks are the ones that are sure to turn up on the critical list where lives are going to be lost. The inspection that was missed, the critical member that was missed, is the one that is going to fail. Safety is so difficult an undertaking, it is always prospective, always looking over the horizon, not dealing with the problem you can see. You are attempting to look into the crystal ball, into the future, and be preventive.

So it is so easy to pass it over, say we will do it later. But it is so important to do it today and to have uniformity. That is what the Board is looking for. That is what this subcommittee is looking for.

Does the NPRM address the Board's concerns about adequate inspections after unusual occurrences, floods, hurricanes, earthquakes?

Mr. BURNETT. No.

Mr. OBERSTAR. Has the Board made recommendations about steps that should be taken to do so?

Mr. BURNETT. I don't think we have made recommendations in that area because we have not investigated an accident that arose from those situations. That certainly may be an issue in the Schoharie investigation.

Mr. OBERSTAR. If you have such recommendations, the subcommittee would appreciate your submitting them for inclusion in the record. We will see to it that the Federal Highway Administration takes note of them.

Mr. BURNETT. Thank you.

Mr. OBERSTAR. On page 9, you address the matter of underwater inspection. How should the NPRM be changed to adequately respond to the Board's recommendations for adequate underwater inspections?

Mr. BURNETT. Well, I think basically in the NPRM they at least took the first step of what we wanted them to do. We suggested they adopt as a mandatory provision the five year cycle for underwater inspections, which had been included in the AASHTO guidelines. However our recommendations looked forward to going beyond that to some research that would develop standards that in some cases might provide for less than a five year standard for some bridges under some circumstances, and there is no sign of that sort of thing in the NPRM.

Dr. **Loeb**. In addition, we have asked them—the Federal Highway Administration—to specify the criteria that should govern the underwater inspection and not leave it to the states to do that, and I would like to make a point that we did recommend that Federal Highway Administration provide a five-year limit on the inspection interval, but that was an interim measure predicated upon their completion of research to determine what an appropriate interval really would be. We weren't sure what an appropriate interval would be, but we did not want to exceed the five years. By no means do we believe that the five years is a reasonable interval in all cases.

Mr. **Oberstar**. Are there any studies that substantiate this five year figure? We have seen this a number of times.

Mr. **Burnett**. As far as I know that was an arbitrarily selected figure that came out of the AASHTO guidelines. We believe it to be—certainly the five years for any bridge that has a critical structural element that has to require underwater inspection would be maximum, but I think all or many of the states, for instance, recognize the need for underwater inspection at much more frequent intervals than that.

Mr. **Oberstar**. You are very conscious of the financial limitations and burdens of an inspection program, and I think the board has been very careful to point out that there are certain circumstances where doing the maximum may excessively drain financial resources, but you also point to certain types of bridges that require this particular effort—bridges over water, bridges with a propensity to flooding, bridges in corrosive environments, complex bridges.

Does the inspection program now adequately address and focus resources on those particular unique circumstances?

Mr. **Burnett**. Not in our view. That is, I don't think there is a disagreement between us and the Federal Highway Administration that there needs to be flexibility. The question is, right now, they are going to leave it to the states to develop the plans under which the flexibility is going to be exercised, and without, in my view, giving assurances that the plans are going to be rigorously examined. And because the states are under resource pressures, as we have mentioned, there may be substantial incentives there for them to be less than demanding, and we may not have effective Federal oversight of that decision making process.

Mr. **Oberstar**. Has the Board submitted recommendations to the Federal Highway Administration on those points that I mentioned a moment ago?

Mr. **Burnett**. Yes sir, on matters that bear on those points.

Mr. **Oberstar**. We would like to include those in the record at this point.

[The following was received from Mr. Burnett:]

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: June 17, 1986
In reply refer to: H-86-03 through -06

Honorable Ray A. Barnhart
Administrator
Federal Highway Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

About 2:01 p.m. central standard time, on April 24, 1985, two 34-foot-long twin spans at the south end of the Chickasawbogue Bridge on U.S. 43 about 2 miles north of Mobile, Alabama fell into water ranging from 10 to 30 feet deep after a steel pile bent 1/ collapsed. Two of the three southbound vehicles on the bridge at the time stopped before reaching the edge of the bridge void. However, one vehicle, a 1979 Ford van, became airborne, struck one of the falling bridge spans, and entered the water. The lone occupant exited the van, swam to shore before the van sank in 20 feet of water, and sustained minor injuries in the accident.

In a postaccident examination of the bridge, divers for the State of Alabama reported that the exposed steel H-piles were severely corroded near the mud line of the creek. The State of Alabama last inspected the Chickasawbogue Bridge on April 3, 1985. However, none of the underwater bridge elements was examined during that inspection. The underwater elements of the bridge had not been inspected by the State since November 1969.

The Chickasawbogue Bridge was designed in accordance with the State Highway Department of Alabama Standard Specifications for Highways, Bridges, and Materials, dated 1950, and in accordance with the American Association of State Highway Officials (AASHO) 2/Standard Specifications for Highway Bridges, dated 1953. 3/ Design on the bridge started in 1952, and the bridge was opened for vehicles in 1958. Initially, the bridge had an estimated design life of 75 years.

In the Gulf States, 4/ steel pile was widely used in the construction of bridge substructures during the 1950s because it was economical and accommodated the rapid construction of bridges. The 1953 AASHO standard specifications for highway bridges suggested the following precaution to compensate for corrosion of exposed steel piles:

1/ For more details, read Highway Accident Report "Collapse of the U.S. 43 Chickasawbogue Bridge Spans near Mobile, Alabama, April 24, 1985 (NTSB/HAR-86/01).

2/ Now the American Association of State Highway and Transportation Officials (AASHTO).

3/ The American Association of State Highway Officials, Standard Specifications for Bridges (The Association, Washington, D.C.) 1953, p. 204.

4/ The five States with coastlines on the Gulf of Mexico are Florida, Alabama, Mississippi, Louisiana, and Texas.

"1/16 inch depth of thickness shall be deducted from all exposed surfaces when computing the area of steel in piles or shells." This particular requirement was not used in the design of the Chickasawbogue Bridge, nor was it a requirement in the Alabama Standard Specifications for Highways, Bridges, and Materials.

At the time of the bridge collapse, the AHD inspected all bridges at 2-year intervals in accordance with the National Bridge Inspection Standards (NBIS) 5/ and inspected the underwater elements of "major" bridges at 5-year intervals. Although there is no universally accepted definition for a major bridge, the State of Alabama generally defines major bridges as those over rivers and those that include complex design substructures or foundations in deep water. The last inspection was made on April 3, 1985, 21 days before the collapse. Since the bridge was not classified as a major bridge, none of the underwater bridge elements were examined during these inspections. The Chickasawbogue Bridge had been inspected at the required 2-year intervals. The last reported inspection of the underwater elements was conducted in November 1969 after the FHWA Regional Office notified the State of the collapse of the Anclote Bridge in Florida due to the corrosion of exposed steel H-piles. At that time, the State examined the underwater elements of several bridges, including the Chickasawbogue Bridge. State highway officials did not uncover any apparent corrosion problems in the substructural elements of the Chickasawbogue Bridge after 11 years of service; as a result, no further underwater examinations were made until the collapse occurred.

The AHD officials were aware of varying water conditions in the vicinity of the Mobile Bay and Mobile River. However, based on the 1969 examination of the bridge underwater elements, the AHD officials thought that the water conditions near the U.S. 43 bridge site were not as corrosive as the water downstream. AHD officials measured the pH and chloride ion concentration of 746 and 278 part per million.

The bridge is located in estuarial waters where a brackish condition exists. Sea water from the Mobile Bay enters the creek and causes variations in the levels of salinity, dissolved oxygen, pH, and water velocity. In addition, tidal influence from the Mobile Bay and the Gulf of Mexico causes a salt water wedge to penetrate the Mobile River and its tributary streams. A report by a consultant for the American Iron and Steel Institute (AISI) on the Chickasawbogue Bridge collapse 6/ stated that a dense salt wedge exists at the bottom of the creek due to incoming tides. Since salt diffuses upward, the presence of the dissolved salts at the bottom of the creek significantly reduced the electrical resistivity of the entire body of water.

In addition to salinity levels of the water, the Chickasawbogue had a long history of pollution problems. The AISI report on the inspection of the collapsed bridge stated that two previous water quality studies had detected the presence of anaerobic bacteria at the mud line of the creek as early as 1958. The report also states that the creek was the receiving stream for various industrial wastes that apparently were high in sulfate content. Because of the tidal influence, effluents from industrial plants discharged either upstream or downstream could have affected the water quality at the bridge site, encouraging the growth of corrosive anaerobic bacteria.

5/ Reference 23 CFR 650.301 to 650.311, "National Bridge Inspection Standards," for details.

6/ Coburn, S.K. Report of Inspection of US-43 Bridge Collapse in Chickasaw, Alabama, August 15, 1985 (unpublished).

The FHWA's report on the 1984 annual bridge inspection program review for Alabama 7/ states that the AHD and all counties reviewed were not meeting the NBIS requirements for posting load limits at bridges. All bridges should be load posted if the operating rating is less than the legal load limit under the State and Federal law. At the time of the collapse, the AHD did not have a formal policy on posting bridges. The FHWA report also suggested that the State consider the following recommendations concerning load posting:

> Recommendations - (1) Design bridges capable of carrying legal loads. (2) Rerate all bridges using truck types and configurations which are compatible with the State legal loads for comparison with the operating rating and, if necessary for compliance, use special rating techniques to give the highest rated capacity of a bridge using acceptable methods. (3) Develop a formal policy on posting and encourage the counties to adopt it.

The Safety Board held a public hearing on this investigation in Atlanta in July 1985. Exhibits and testimony were entered into the record to assemble a comprehensive, factual docket of information on this accident and the bridge inspection programs within various States. Officials of the AHD, FHWA, AASHTO, AISI, U.S. Army Corps of Engineers (COE), and the National Bureau of Standards (NBS) provided testimony on the construction, maintenance, and inspection of the Chickasawbogue Bridge, and on the National Bridge Inspection Program, Federal oversight responsibilities, factors influencing the corrosion of exposed steel piles in marine environments, and appropriate countermeasures to retard corrosion.

FHWA officials who testified at the public hearing stated that the 5-year cycle for underwater inspection, suggested in the AASHTO manual, was not based on research but on the best engineering judgment available at the time the AASHTO manual was written. FHWA officials stated that they did not question the State's bridge inspection program or determination of "major" bridges because they felt the professional engineer in charge of the program was knowledgeable about the bridges within the State and was able to determine which bridges should and should not be subjected to underwater inspections. The FHWA officials stated also that in retrospect they probably should have asked more questions during the annual review process to clarify Alabama's policy on inspecting nonmajor bridges.

FHWA officials also stated that after the collapse of the Anclote River Bridge, only the States within the same FHWA region were notified of the circumstances and causes of the collapse. However, the results of the followup inspection program by the State of Florida were not disseminated. After the collapse of the Chickasawbogue Bridge spans, all 10 FHWA regions were notified and requested to take appropriate steps to make certain that all States had well-founded underwater inspection programs that identified the criteria, procedures, frequency, and followup methods necessary to comply with the requirements of the NBIS. Again, the results of the followup inspection program by the State of Alabama were not disseminated.

At this time, many States do not comply with either the 2-year inspection cycle specified in the NBIS or the 5-year inspection cycle suggested in the AASHTO manual for underwater inspections. A 1980 study prepared by the Transportation Research Board indicated that 35 States do not routinely inspect bridge substructures below

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the waterline. Out of the 15 States that do conduct routine underwater inspections, 14 perform these inspections every 5 years or less. Because of the apparent lack of uniform policy on the underwater inspection of bridge elements, most States perform these inspections only when problems are suspected.

The detail, type, and frequency of the underwater inspections are left to the discretion of the State highway officials. Both FHWA and AASHTO provide only suggested guidelines on underwater inspections, guidelines that do not identify specific details for inspecting the underwater elements of bridges based on the foundation type, substructure complexity, and water conditions the bridge is subject to. The Safety Board believes effective criteria are needed to assist the States in developing programs for the underwater inspection of bridges.

In addition to the lack of underwater inspection criteria, the FHWA and AASHTO do not provide effective criteria for determining acceptable tolerances for bridge span misalignment or expansion joint openings. The AASHTO manual suggests that measurements be recorded, but does not provide the methodology for recording measurements or for identifying potential causes of span misalignment or abnormal expansion of joint openings or closures. The FHWA Bridge Inspector's Training Manual, on the other hand, does stress that excessive misalignment should raise questions regarding the condition of the bridge. However, the manual does not provide written, objective, dimensional standards for measuring the alignment of bridge structural members. If alignment measurements are recorded routinely during the normal above-water bridge inspection, the bridge inspector may determine if a substructural member has shifted, and may request a detailed underwater inspection to identify the cause(s) of shifting. The Safety Board believes that objective criteria should be developed to assist States in these areas.

In the 1984 annual review of the bridge inspection program in Alabama, the FHWA noted that the State did not meet the NBIS requirements for load-posting bridges, nor did the State have a formal policy on load posting. As a result of the bridge span collapse, Alabama recently completed an intensive bridge underwater inspection program to determine section losses for steel and concrete piles. The Safety Board suggests that the compiled data will be used to develop a statewide load posting program that accurately reflects the true operating rating for its bridges. The condition of the underwater elements is an important part in determining the safe load capacity of bridges. The Safety Board encourages other States to accurately assess the safe load capacity for bridges over water before establishing or updating existing statewide load-posting programs.

Because of constantly changing environmental and loading conditions, most bridge designers cannot predict the life of bridges. Periodic inspections are necessary to make certain that all potential problems are detected early to minimize the potential for catastrophic failures. Design allowances and corrosion control methods will delay the corrosion process for steel piles, but will not prevent it completely. No foundation type (i.e., steel, concrete, or timber) is immune to corrosion or the loss of section integrity.

Effective, timely inspections are key to accident prevention. This accident could have been prevented had the State periodically inspected the underwater elements of its "nonmajor" bridges. Continued inspections of underwater bridge elements are required to ensure that the structural integrity of bridges is maintained, and that the maximum operating rating is appropriate. Spot checks should also be done to identify damage resulting from adverse weather and environmental situations.

As a result of its investigation of this accident the National Transportation Safety Board recommended that the Federal Highway Administration:

> Establish criteria for inspecting the underwater elements of bridges which consider the following factors as they relate to bridge design and maintenance:
>
> Complexity of structure and materials used,
> Marine environment surrounding the underwater elements of the bridges, and
> Frequency and magnitude of loads on the bridge.
>
> (Class II, Priority Action) (H-86-3)
>
> Until research has been conducted to establish the appropriate inspection cycle, require all States to inspect the underwater elements of bridges on a 5-year cycle as suggested in the 1983 American Association of State Highway and Transportation Officials Manual for Maintenance Inspections of Bridges, unless more frequent inspections are performed. (Class II, Priority Action) (H-86-4)
>
> Require State highway officials to determine the safe load capacity for all bridges. Ensure that the underwater elements of all bridges over water have been recently examined before the safe load capacity is determined. (Class II, Priority Action) (H-86-5)
>
> Work with the American Association of State Highway and Transportation Officials to develop procedures for examining the substructural elements below water, considering the size, type, complexity of the bridge design, and the marine environment; develop effective criteria for determining acceptable tolerances for bridge span misalignment and expansion joint openings or closures which identify dimensional standards for the alignment of bridge spans. (Class II, Priority Action) (H-86-6)

GOLDMAN, Acting Chairman, and BURNETT, LAUBER, and NALL, Members, concurred in these recommendations.

By: Patricia A. Goldman
Acting Chairman

Mr. **Clinger**. Thank you, Mr. Chairman.

Chairman Burnett, in your testimony I think you mention the desirability of having a national inventory for bridges. We currently have in effect an inventory which tells us generally how many bridges we have out there. One of the things that we had hoped to be able to accomplish through the rather limited capital budget we have in place would be a more comprehensive, useful inventory.

We don't have that kind of inventory now, do we?

Mr. **Burnett**. Well, for instance, we can't answer the question how many bridges with spread footing do we have in the country. That would be of a certain size or complexity. We can't answer that.

Mr. **Clinger**. How can we develop that kind of data?

Dr. **Loeb**. We need to modify the SI&A forms, and I think that work is being done by the Federal Highway Administration. Again, one of the problems is the cost involved in collecting detailed information.

Incidentally, one of the things we learned in the investigation of the Schoharie Creek accident is that in some cases the States are not always aware of what kind of bridge they have. They might not know that the bridge was built on spread footings without pilings, and if they don't know that, it is unlikely that would be on the form, and, of course, the information is not required to be on the form. So the information is worse than just not having that information on the form, in some cases, you cannot go behind the form and get the information.

Mr. **Clinger**. That form, if it were to be revised, as you are suggesting here, that form would come to Federal Highway Administration, they would be a central clearing house?

Dr. **Loeb**. There is a computerized system set up by which information does go into a data bank that the Federal Highway Administration collects. There are also states that have their own computer systems and they store information as well. So there is both systems available, but the Federal Highway Administration system is dependent upon the bridge inventory form.

Mr. **Clinger**. Which at the present time is inadequate?

Dr. **Loeb**. That is correct.

Mr. **Clinger**. I am advised that during both the Mianus and Chickasawbogue Creek investigations, it was discovered that state inspectors either did not measure for or did not record span misalignment during inspections of those two bridges. It was also noted that the Federal Highway Administration and AASHTO do not provide criteria for determining allowable ranges of tolerance for span misalignment.

Can you tell us what criteria you would like to see developed to allow for a more accurate recording of details such as span misalignment?

Mr. **Burnett**. We certainly wouldn't set ourselves as being able to develop the criteria.

Mr. **Clinger**. Has FHWA or AASHTO done anything in this regard?

Dr. **Loeb**. Yes. There has been work done in that regard.

Mr. **Clinger**. Since your investigation of the Mianus and Chickasawbogue Creek Bridge collapses?

Dr. **Loeb**. That is correct.

Mr. **Burnett**. The situation with span misalignment is a diagnostic device that you can accomplish with relatively little effort, I suppose, and it is not being used to the extent that we think it needs to be.

Dr. **Loeb**. It is probably one of the most important, and probably one of the easiest signs, manifestations of a bridge problem that exists. So it is a critical issue to be dealt with. We believe that work has been done, but we believe more needs to be done.

Mr. **Clinger**. So that we could come up with a fairly standard set of criteria on this issue, which could be then made applicable nationwide?

Mr. **Burnett**. One which a bridge inspection engineer could use to determine whether or not a misalignment indicates a real problem with the bridge, and, of course, again this is one of the reasons for needing to have a series of good inspections so that you can compare them and see whether or not they are changing, or whether or not you have got a static situation.

Mr. **Clinger**. You are recommending that before any kind of permission is granted to extend the time between inspections, there ought to be a pattern established of two inspections over a two year period?

Mr. **Burnett**. Two maybe successive years, two years apart.

Mr. **Clinger**. Do we presently have enough knowledge up on which to determine when you are safe to let it go for five years? Do we have enough empirical data to be able to say we can go through the two year inspection and we can give you a clean bill of health for five years?

Mr. **Burnett**. That needs to be discussed with the Federal Highway Administration. My sense of this is that, we are not talking about original. There has been an awful lot of observations done on these engineering issues, and what it takes is to draw from the literature the information that is needed and put it in a form that can be used as part of the bride inspection program. The Federal Highway Administration may disagree with that and certainly I would yield to their expertise.

Dr. **Loeb**. I certainly think on certain types of bridges, enough is known probably that with two inspections over a one to two year period of time, yes we could feel safe in extending the interval.

Mr. **Clinger**. With the understanding, that if there were a major flood or other extraordinary event during the five year period, you could spell the five year period and have an inspection mandated at that time?

Mr. **Burnett**. Very definitely.

Mr. **Clinger**. Thank you very much, Mr. Chairman.

Mr. **Oberstar**. Mrs. Johnson.

Mrs. **Johnson**. Thank you very much, Mr. Chairman.

Just one followup question.

You found that the Federal Highway Administration had not adequately transferred technological materials that were available on the inspection of pin hangar assemblies to the states when you investigated the Mianus River bridge collapse. Are there other instances in which technological transfer did not take place of known materials? Exactly what did you mean by that in your comments about the Mianus bridge?

Dr. **Loeb**. Well, I think in the case of Mianus there was information the Federal Highway Administration had that it had not transmitted formally, although there are informal channels of communications between the states and the Federal Highway Administration. I don't think that this was of concern in that particular incidence of the of the Mianus bridge collapse.

However, I don't think this is a major problem. I think the communications does exist between the states and the Federal Highway Administration, although we certainly would like it to be improved. I think that the far more larger issue is that of the oversight of the inspection program, and maintenance programs that go on.

Mrs. **Johnson**. In other words, the real question is what the hands on use of that material is. Would you then say that the material that is being transferred to the states by the FHWA and AASHTO is updated regularly and tends to be state of the art material?

Dr. **Loeb**. I think in general that is the case. Obviously, we would like to see greater communications, more rapid communications, but I think in general the Federal Highway Administration does make what information it has available to the states.

Mr. **Burnett**. I think, to add to that, I think following these two bridge collapses that we have investigated—this may also have taken place in Schoharie—there is a network in existence for getting information out to the states, and you did see, after Mianus, states starting to take a good look at hangar bridges. After Chickasawbogue Creek, the underwater inspection issue, especially where there were "H" pilings, that type of construction got a better look through the network that takes place there.

So that is one of the, I guess, one of the values of the bridge inspection program that we have in place is there is a lot of informal flow, but not a whole lot of tough regulatory type action.

Mrs. **Johnson**. Do you think that the provisions in the bill we recently passed, that requires federal training of bridge inspectors, will to some extent improve the quality of the information transfer?

Mr. **Burnett**. I think standardized training certainly of inspectors being done with the resources of the Federal Government and the kind of centralized program that can be provided there, would be a big—having seen that operate in other contexts—I think it holds a lot of hope for improvement.

Mrs. **Johnson**. Thank you very much.

Thank you for being with us this morning.

Mr. **Oberstar**. Thank you.

Just a few closing questions.

If the proposed flexible schedule of bridge inspection is adopted as proposed in the NPRM and in place of the current two year frequency, what problems might the Federal Highway Administration face in their oversight and in their reporting to Congress on the status of the bridge program? What things might be missed?

Mr. **Burnett**. Well, again, I think that a two year interval, the introduction of the flexible approach, is something that they could handle and handle adequately. So that does not represent a derogation of safety. In my view, in order to do that, they will have to set up a system whereby they take a good, rigorous look at each one of the state plans and are willing to say no, if the plan does not meet their standards.

Since I get no indication from the NPRM they have established standards in advance for what they are going to approve and not approve, it seems that the intellectual leadership in the whole process is going to go to the states, and that may not be all bad, because some states may do a real good job of it. Then they may come forward with plans that seem to be good and others may model theirs after them.

But with the kind of resource pressures that would exist in a time when we have so much of an infrastructure problem and so many demands on our resources, I think in a lot of cases you are going to see states submitting plans that are based primarily on the idea of getting themselves out of some expenses.

Mr. **Oberstar**. I think you are exactly right.

Mr. **Burnett**. If the Federal Highway Administration does not have a defense against that, then we are going to have problems. So, I am not conceptually against what they are doing, but it seems to me that they are going at it backwards.

Mr. **Oberstar**. Well, I share your concerns. That is why I asked the question.

I am also concerned that we aren't going to have the yardstick by which to measure effectiveness of these various programs. You can have so much flexibility that you have nothing solid on which to measure your progress, or dependability of the inspection programs.

Earlier in your testimony, you indicate that annual reviews of state bridge inspection programs are essentially paper audits. We have discussed that somewhat. Why are they becoming increasingly paper audits—lack of manpower?

Mr. **Burnett**. I think it is important to recognize by necessity the way the systems operated the audit is going to be an audit, it is not going to be a direct inspection of the bridges.

If you do not have the resources to go out and spot check, to determine the reliability of the paper that you are looking at, I think that the Safety Board investigations would still be a paper audit, be an audit of their paper, but at some point you have got to determine whether or not the paper is being drawn from a process that in itself has integrity. And I don't think the system is organized to do that now.

I think that is a policy decision that has been made that needs to be reviewed and it is probably resource driven in terms of the Federal Highway Administration, the kind of resources they want to devote to that, as well as the fear that if they had a much more aggressive program that they would wind up forcing the States to divert resources from other issues to the bridge inspection.

Mr. **Oberstar**. Well, it is a very dangerous situation when safety is left to the forces of, as you put it, resource driven, when you can cop out by saying we don't have the money, don't have the people, therefore, we won't do the inspection, we will just write things on paper. We have seen some very serious problems develop in that area, and other transportation safety questions, and that is a matter of great concern to us.

Finally, is the board aware of recent developments in bridge inspection technology or inspection procedures that are not yet in widespread use by the States but should be?

Dr. LOEB. Yes. In fact, we have made recommendations in the past about inspection techniques, especially the use of equipment to be able to inspect areas of bridges that you can't visually inspect without the use of equipment.

Even, I guess, more importantly, is the inspection of the underwater elements, and there are now techniques being developed to give some early warnings of potential underwater problems, such as scouring. These techniques, although in many cases just in the early stages, there are some things that have been around for a number of years that could be used.

I think that is an important issue, and I think there is a need to do more research. We may be discussing that with the Federal Highway Administration eventually, to do more research into techniques and use of new pieces of equipment to monitor the condition of their underwater elements of bridges.

Mr. OBERSTAR. Such as, well for example, using articulated arms cranes that can reach over the edge of a bridge and come up underneath with the inspector in a basket looking at the under-bridge members?

Dr. LOEB. That is correct. The Snooper type of devices and so forth.

Mr. OBERSTAR. What about techniques or technologies that are used in other transportation modes? Aviation, for example has some structural member inspection technology, that is of course peculiar to aviation, but may be a higher level of testing than you might think of for bridges. Have you looked at any of that for cross technology adaptation?

Dr. LOEB. We have had an opportunity to explore to some limited extent the use of such equipment as x-ray equipment or ultrasonic equipment that may be used in aviation, and in some cases, these types of equipment are used for bridge inspection, but to a limited extent, I am sure that greater use of these types of equipment can be made in the future, and we will be looking at that as well.

Mr. OBERSTAR. Anything such as the borescope technology that can be useful in detecting early signs of corrosion?

Dr. LOEB. Absolutely, for getting into inaccessible locations and so forth.

Mr. OBERSTAR. Thank you very, very much for your presentation and for your help.

[Mr. Burnett's prepared statement follows:]

National Transportation Safety Board
Washington D.C. 20594

Safety Information

Testimony of
Jim Burnett, Chairman
National Transportation Safety Board
before the
Committee on Public Works and Transportation
Subcommittee on Investigations and Oversight
House of Representatives
Regarding
Bridge Inspection and Safety

December 1, 1987

Mr. Chairman, I appreciate this opportunity to be here with you this morning. The Safety Board is grateful for this Committee's continued interest in improving bridge safety and inspection, and you are to be commended for holding these hearings to further this cause.

Safety Board concern for bridge safety and inspection was brought into sharp focus following the sudden, shocking collapse of the bridge which carried U.S. Highway 35 over the Ohio River between Point Pleasant, West Virginia and Kanauga, Ohio on December 15, 1967. The collapse took with it 31 vehicles, killing 46 people and injuring nine. The Board determined that the probable cause of the collapse was a fracture in an eye of the eyebar suspension chain caused by a flaw resulting from stress corrosion and corrosion fatigue. The Board noted that the flaw could not have been detected by any inspection method known at that time.

In view of the severity of the accident and the complexity of the issues involved, the Secretary of the Department of Transportation (DOT) created a committee to examine the procedures, standards and criteria being used to provide for bridge safety throughout the country.

The committee, headed by the Chairman of the National Transportation Safety Board, also was tasked to make recommendations for improvements. The result was the establishment of the National Bridge Inspection Standards (NBIS) which are the basis of current bridge inspection regulations.

More recently, the Safety Board has investigated and reported on two accidents involving major collapses of highway bridges -- the collapse of the bridge carrying Interstate 95 over the Mianus River in Greenwich, Connecticut on June 28, 1983 and the collapse of the Chickasawbogue Bridge near Mobile, Alabama on April 24, 1985.

In the Mianus investigation, the Board determined that the cause of the collapse was the lateral displacement of hangers by corrosion-induced forces due to deficiencies in the State of Connecticut's bridge safety inspection and bridge maintenance program. The probable cause determined in the Chickasawbogue Bridge collapse was undetected deterioration of steel H-piles due to inadequate inspection of the underwater bridge elements by the State of Alabama. Contributing to this accident was the failure of the Federal Highway Administration (FHWA) to adequately oversee the bridge inspection program of Alabama in accordance with the National Bridge Inspection Standards.

Currently, the Board is investigating the collapse, near Amsterdam, New York of the New York State Thruway bridge on Interstate 90 over the Schoharie Creek on April 5, 1987. In this accident, the adequacy of bridge inspection is also of concern.

Although the probable cause has not yet been determined, there is evidence that there was less than adequate inspections, with no inspection of the underwater elements of the bridge since it was constructed.

Federal regulations currently require bridge inspections by the states at a minimum of every two years; the regulations also require the states to determine the type and depth of the inspections. The FHWA provides guidelines and checklists for conducting bridge inspections. However, the states are not required to follow the guidelines or use the checklists. The FHWA does perform an annual review of the states' inspection programs, but these reviews do not always uncover the weaknesses in these programs.

The Safety Board found in its investigation of the collapse of the Mianus River Bridge, and again in its investigation of the collapse of the Chickasawbogue Bridge, that the annual reviews of the state bridge inspection programs performed by the Federal Highway Administration are essentially "paper audits." Reviews by the FHWA division, region and headquarters do little more than verify that state bridge inspection reports -- the Structure Inventory and Appraisal Sheet (SI&A) -- are completed and that all the boxes are checked on the SI&A sheets. The SI&A condition statements were developed to establish priorities for rehabilitation or replacement projects. The FHWA personnel do make some field visits to observe bridge inspectors in action, but the frequency of such visits is not sufficient for FHWA personnel to observe the inspection of all types of bridges within the states.

For example, in Alabama, before the Chickasawbogue Bridge collapse, the division FHWA personnel had never accompanied state inspectors on an underwater inspection, even though many of the states' bridges have substructure elements underwater. Unfortunately, given limited staff, there may be only one structural specialist in an FHWA division, and that specialist generally will have other responsibilities such as processing applications for bridge rehabilitation.

The need for a proper audit of the compliance by states with the National Bridge Inspection Standards was pointed out in the Safety Board's report on the Mianus River Bridge collapse. The Board concluded that a proper audit of the State's procedures should include, among other things, a careful review and evaluation of a significant sample of the bridge inspection reports, with special emphasis placed on reports on complex bridges. A proper audit should also include a review of the number of hours spent on inspection of bridges, a review of the equipment used in inspection (such as a "snooper," scaffolding, ultrasonic, radiographic, etc.), a review of management policies and procedures and a review of the inspector's training programs. The Safety Board also concluded that a proper audit should include unannounced visits to bridge sites during regular inspections.

As a result, the Safety Board recommended that the DOT direct its Inspector General to review the adequacy of the FHWA's program of auditing state compliance with the NBIS. The Safety Board placed this recommendation in a closed, acceptable action status after the DOT told the Board that three Inspector General audit's of FHWA bridge programs had been expanded to include bridge inspection and that the DOT was also committed to review the FHWA's effectiveness in obtaining such compliance.

The Safety Board also recommended to the FHWA that it develop detailed, comprehensive and integrated bridge inspection procedures using all available source materials, including FHWA and American Association of State Highway and Transportation Officials (AASHTO) inspection and training manuals. The Board further asked the FHWA to amend the NBIS regulations to include an integrated bridge inspection in its entirety or by reference and to augment the current inventory and rating methodology of the NBIS to require inspections and rating of sufficient depth and detail to address all elements critical to safety. About a year ago the FHWA informed the Board that the inspection and training manuals would be modified and that the NBIS would be revised.

As this Committee knows, the Federal Highway Administration published a Notice of Proposed Rulemaking (NPRM) on April 7, 1987 on "National Bridge Inspection Standards; Frequency of Inspection and Inventory." However, this NPRM, which proposes to lengthen the time between inspections, to modify the minimum requirements for supervisory inspection personnel and to require entering in state records within 90 days of inspection data on newly load-posted bridges, does not address the Board's recommendations. On July 8 the Safety Board commented that, in the collapse of the bridges over the Mianus River and the Chickasawbogue Creek, the quality -- that is, the extent and detail -- of the inspections were of more concern to the Safety Board than their frequency, as these bridges had been inspected nine months prior to and 21 days prior to their collapses, respectively.

The Safety Board further commented that the NPRM was inappropriate in view of the unresolved issues related to the collapse of the Schoharie Creek Bridge and other bridge failures that have recently occurred in the northeastern United States. In fact, there are bridges with unique designs, older structures or harsh environments which may require inspections at intervals of less than two years to provide for adequate public safety. For example, bridges over water probably should be thoroughly inspected after each significant flood.

The Federal Highway Administration and the AASHTO have long recognized that a shorter inspection cycle may be necessary for bridges which have unique design features. Further, apparently not all states accept the FHWA's current two-year cycle as adequate, as some states require a one-year cycle for inspections of some or all of their bridges. This NPRM does not adequately address these points.

As stated in the NPRM, it may be acceptable to allow longer inspection cycles for some bridges, but the Safety Board believes this should not be permitted until after a bridge receives a thorough, comprehensive inspection, followed by a similarly thorough inspection one or two years later. Should these inspections reveal no major discrepancies, then it may be a candidate for longer inspection cycles. Determination of the frequency of inspection must be based on the nature, condition and environment of the bridge and the type and extent of the inspection it will receive.

An example of a type of bridge cited by the NPRM as one which may not require a two-year inspection is a concrete box culvert. It is certainly no significant engineering feat to design nor inspect such a structure. Other bridges which may not require two-year inspections are those of standard design, multi-redundant bridges over land, highways or railroads that have been used successfully for decades. But again, we believe that even these structures should receive, before being considered for a longer inspection cycle, at least two comprehensive inspections within a one or two-year period. In addition, all structures should receive an inspection immediately after an unusual occurrence such as an earthquake or, in the case of bridges over water, a significant flood.

Investigation of the collapse of the Chickasawbogue Bridge revealed that many states were not performing underwater inspections of their bridges. Further, the inspections performed by some of those states doing underwater inspections were not sufficiently thorough.

In April of 1986, about a year before the collapse of the Schoharie Creek Bridge (and the issuance of the NPRM), an FHWA Associate Administrator wrote to each regional Federal Highway Administrator that "Each Regional Office should provide appropriate leadership and direction to Division Offices to ensure that States have developed and are carrying out a soundly based underwater inspection program." FHWA divisions then required each state, as part of its bridge inspection program, to have written criteria specifying the conditions under which underwater inspections are necessary, the bridges needing such inspections and the frequency of such inspections. Unfortunately, there was no requirement that such inspections had to be done within a specific time, although the FHWA did refer to the AASHTO Manual for Maintenance Inspection of Bridges which recommends a maximum of five years between underwater inspections.

However, the Safety Board remained concerned that without specific criteria set out by the FHWA, the states might not develop and implement underwater inspection programs which would take into account all of the components required for a good inspection. As a result of the Chickasawbogue accident, the Safety Board, in April 1986, recommended that the FHWA establish criteria for the inspection of the underwater elements of bridges based on factors such as the complexity of the structure and the materials used, the marine environment and the frequency and magnitude of the loads on the bridge. The FHWA informed the Safety Board that it was preparing an NPRM on the NBIS. The NPRM issued in April does propose that states identify and maintain a master list of bridges, with underwater members which cannot be visually evaluated during low tide or by feel. The NPRM proposes that underwater members must be described and the inspection procedures must be stated. The NPRM also proposes that the inspection frequency not exceed five years; this is responsive to one of the recommendations made as a result of the collapse of the Chickasawbogue Bridge. However, the NPRM does not adequately respond to the recommendation for the establishment of criteria for the underwater inspection.

The frequency and extent of underwater inspections should be dependent on such factors as the nature of the stream channel, the velocity of the stream, the type of footing, and the type of structure. If a stream has a history of turbulent flow, such as the Schoharie Creek, and the bridge is non-redundant and on spread footings, more frequent and more thorough inspections are required than for a bridge located in a placid body of water.

The Safety Board has been unable to learn from FHWA or AASHTO how many bridges there are in the United States like the Schohari Creek Bridge, because the data needed to determine this is not requested on the SI&A report form. However, it has been reported to the Safety Board that the State of Virginia alone has more than 400 such bridges. One of these Virginia bridges collapsed during a flood on September 7, 1987.

Following the FHWA's action in the spring of 1986, New York State embarked on a program to conduct underwater inspections of their bridges, and the New York State Thruway Authority bridges were included in the program. The Schoharie Creek Bridge was proposed to receive an underwater inspection. Unfortunately, before an underwater inspection contract was let, the April 1987 flood occurred and the bridge collapsed. I think it is worth noting that since the collapse of the Schoharie Creek Bridge, the State of New York has been conducting underwater inspections of its bridges and has completed the inspection of a substantial portion of its bridges requiring such inspections.

Currently, there remains a debate among the engineering profession and firms providing underwater inspection services as to whether an engineer should be required to accomplish the underwater inspection. Some states believe that a diver, given some training, can sufficiently relate to an engineer the condition of the substructure below water.

The Safety Board is not convinced that this approach is completely valid. Certainly, if such an approach is followed, the diver's training must be very comprehensive, and if there are any reservations about the condition of the substructure, an engineer/diver should be required to inspect the substructure.

Clearly an inspection team including a civil engineer -- especially one with a hydraulic background -- a maintenance engineer and a diver would provide a significantly enhanced level of safety. We recognize that the use of such teams for the inspection of all its bridges would pose a substantial burden on a state. However, it should not be an unreasonable burden to use such teams on certain unique bridges, such as bridges over water with a propensity to flood, bridges in corrosive environments and bridges which are very complex.

The agency, the engineer and the inspector must know the bridge, its history and its environment, and understand, in detail, what to look for in an inspection. Had this been the situation, the Mianus and Chickasawbogue Bridges, (and perhaps even the Schoharie bridge), may well not have collapsed.

The NPRM does provide that any state proposing a longer than two-year inspection cycle for bridges should submit a detailed proposal and supporting data to the Federal Highway Administration for approval. In theory, this should provide protection against less than careful selection of candidate bridges. However, because of the FHWA's past record of overseeing state bridge inspection programs and its limited resources, the Safety Board is not certain that this provision will assure that the safety of the selected bridges is not compromised by longer inspection cycles.

In the NPRM, the FHWA suggests that if 30 percent of the Nation's bridges warrant a two year cycle, this could provide an $8.4 million savings in annual inspection costs. The Safety Board does not know if 30 percent is a reasonable estimate or not. We do believe, however, that the FHWA should establish a realistic estimate of the number of bridges that may be placed on a longer inspection cycle to accurately determine whether the potential savings in the costs of inspections will significantly exceed the costs related to potential risks. Further, the FHWA should consider encouraging the states to use the savings that accrue from ultimate revisions of the inspection interval for simple bridges to perform more comprehensive team inspections of those bridges more complex in design.

Beyond the team concept of inspection for certain bridges, the FHWA should also consider the value of requiring super-comprehensive inspections, perhaps every ten years, for complex bridges, especially those over rivers and creeks prone to flood or those which are subject to harsh environments. Although bridges are basically static structures, their environments are very dynamic and their conditions can change dramatically over time.

The Safety Board has not investigated any accidents involving collapses due to improper posting of bridges. In fact, we are aware of several collapses of minor bridges which were properly posted but which drivers attempted to cross with heavier loads despite the posting. Signs, unfortunately, do not always prevent excessive loading of bridges.

The FHWA has taken a fairly vigorous stance on load posting of bridges and recently suspended temporarily federal aid funds to at least 144 jurisdictions that have not followed recommended practices. However, the Safety Board remains concerned about the determination and posting of the proper load-carrying capacity of bridges. In its report on the collapse of the Chickasawbogue Bridge, the Safety Board expressed its concern that the State of Alabama did not have, at the time of the accident, a program of load posting which met the NBIS requirements. The Safety Board's concern was that the load-carrying capacity reflect the true operating rating of the bridge based on the actual condition of the underwater elements of the bridge. Accordingly, following its completion of the investigation of the accident, the Board recommended that the FHWA require state highway officials to determine safe load capacity for all bridges based on recent examination of underwater elements of the bridges.

The FHWA responded to the Board that the NBIS and the AASHTO Manual on bridge inspection adequately address the elements to be evaluated, including underwater inspection, in determining the safe load capacity of bridges. It further stated that if underwater inspection unveiled conditions that affect the safe load capacity, it would be recalculated. The Board responded earlier this year asking the FHWA to explain what work it is doing to assure that states are performing the required underwater inspection. The Safety Board is awaiting a reply from the FHWA.

The Safety Board is concerned about the collapse of three major bridges (and numerous lesser bridges) in less than four years. We believe that these collapses suggest that the current bridge inspection program, including the oversight of state inspection programs by the FHWA, needs improvement. We further believe that great care must be exercised before permitting any increase in the interval between inspections of bridges.

That concludes my formal testimony, Mr. Chairman. I would be pleased to respond to your questions.

Mr. **Oberstar**. Our next witnesses will include the panel consisting of Mr. James Roberts, Chief, Division of Structures, California Department of Transportation and Chairman of the AASHTO Subcommittee on Bridges and Structures; J. William Burns, Commissioner, Connecticut Department of Transportation, accompanied by Mr. William A. Lazarek, Deputy Commissioner, Connecticut Department of Transportation; John K. Mladinov, Executive Deputy Commissioner, New York Department of Transportation, accompanied by George Christian, Chief of Bridge Inspection Section, New York State Department of Transportation.

[Witnesses sworn.]

Mr. **Oberstar**. We greatly appreciate your participation in the committee's hearings, the very considerable efforts that each of you go to in preparing testimony dealing in detail with the issue at hand, and several different perspectives you represent in presenting this testimony, and we look forward to your presentation.

Mr. Roberts, we would like you to lead off.

TESTIMONY OF JAMES ROBERTS, CHIEF, DIVISION OF STRUCTURES, CALIFORNIA DEPARTMENT OF TRANSPORTATION AND CHAIRMAN OF THE TECHNICAL COMMITTEE ON BRIDGES REPLACEMENTS AND SURVEY AND INSPECTION STANDARDS; J. WILLIAM BURNS, COMMISSIONER, CONNECTICUT DEPARTMENT OF TRANSPORTATION, ACCOMPANIED BY WILLIAM A. LAZAREK, DEPUTY COMMISSIONER; JOHN K. MLADINOV, EXECUTIVE DEPUTY COMMISSIONER, NEW YORK DEPARTMENT OF TRANSPORTATION, ACCOMPANIED BY GEORGE CHRISTIAN, CHIEF OF BRIDGE INSPECTION SECTION

Mr. **Roberts**. Mr. Chairman, I have submitted 12 pages of written testimony for the record. I would like to paraphrase.

Mr. **Oberstar**. The entire written submission will be included in full in the record and you may summarize the highlights or key points of your testimony, and we will proceed from there.

Mr. **Roberts**. For the record, I am the Chairman of the Technical Committee on Bridge Replacements and Survey and Inspection Standards, not Chairman of the Subcommittee on Bridges and Structures.

Beyond these prepared remarks, we will be glad to answer orally questions and submitted responses in writing at your request.

There have been several references to AASHTO standards and, just for the record, the American Association of State Highway and Transportation officials was founded in 1914 for the express purpose of the development and promulgation of voluntary technical standards guiding the planning, design, construction and operation of highways and their appurtenances including bridges.

The organization functions through individual efforts, task force activities, requested research, which we fund, throughout the various states and suggested changes, additions, deletions, to the published manual that we use. Any of these changes require a two-thirds majority of 50 member organizations which include 48 States, Puerto Rico and the District of Columbia.

The relevant documents that we use in the structures areas of standards and specifications for highway bridges, and most importantly, for this subject today, the manual for maintenance inspection of bridges, which we produce as a guideline for bridge inspection and maintenance.

It needs to be noted that the AASHTO voluntary standards and policy documents are not themselves binding upon the States, since the association has no legal power over the States. However, as a practical matter, these have been adopted almost universally as a minimum standard and the Federal Highway Administration normally accepts these documents in their consideration for developing national standards.

Many states, of course, use them as a guide and while they provide a minimum standard, many states also provide additional requirements as necessary in their individual areas.

To respond to the question on our view on the NPRM, we agree with many of the comments that have been given the previous testimony. AASHTO's Policy Committee has not developed a formal policy. However, it is our role to draw attention to the member departments and encourage their direct response. I believe 34 states responded to this document item.

The Subcommittee on Bridges and Structures is empowered to amend AASHTO technical guides and policies each year and we meet annually to do so, and have addressed some of the issues that have been discussed today, and I will cover them in my testimony.

The Chief Bridge Engineer of each of the 52 member organizations is the voting member of that committee that adopts these changes in standards. The bridge inspection frequency issue has been discussed thoroughly.

I think I would like to summarize by saying that the increase in frequency is not automatic, as the NPRM states. It does have to be submitted to the Federal Highway Administration for approval, and then approval is conditioned on a documented analysis with supporting data and would consider such factors as past experiences of that bridge or bridges of that type.

Known conditions of members, components and the structures and total and type and frequency, and hence the live load stresses that the bridge has been subjected to, that is an important consideration. Not only the age but loading conditions that it has been subjected to.

Once approved, once this variable frequency which would be approved, and given the computer capabilities available today, we believe it is as simple as adding an additional field to the NBIS data base, to show the frequency of inspection for the States.

As I am sure you all understand, there is no one day in the year when we can say this is a State of the bridges today, this is the date upon which the reports are submitted by the inspections, as you have covered earlier, have been conducted throughout the year. So the frequency of inspection would not really affect the state of the structure. But it should be noted in the NBIS data base.

The most recent complete revision to the manual on Maintenance and Inspection of Bridges, produced by the AASHTO Subcommittee, was in 1983, and at that time the States voted to include the language which I will quote:

> Each bridge is to be inspected at regular intervals not to exceed two years, by personnel having the necessary qualifications as previously stated. However, the maximum inspection interval may be increased and/or the depth of the inspection may vary for certain types or groups of bridges, for such action as justified by past inspection reports, and favorable experience and analysis.

There is certainly a good rational engineering basis for variable frequency inspection and it has been covered fairly completely in the earlier testimony. This would be based on the design of the structure, the construction of that structure, and historical performance, the type of material, loading conditions, and so forth.

We would agree with Mr. Burnett that on a new bridge, certainly a first or second annual, biannual inspection would be important. It is certainly not reasonable to assume that a new structure is flawless. You need to develop some history on that structure or that type of structure.

There are, however, as has been covered earlier, many structures in this country, and in the West, monolithic concrete structures, that simply don't have joints, don't have bearings, really don't have the problems that would require an in depth inspection biannually. However, in those same areas there are States, there are structures which would require more frequent inspections. In fact, in some States, such as in our State of California, we have resident maintenance inspectors and bridges such as the San Francisco-Oakland Bay Bridge, a very large structure, two maintenance inspectors are employed full time to inspect those bridges. I think that is an individual decision by States. I will mention that later.

There was some concern by one of the critics of the new language that there would be a detraction from the neatly supplied columns of numbers in the reports given to Congress. I think this issue has been discussed thoroughly in earlier testimony. The columns and numbers aren't so important as what went into the generation of those numbers.

With assigned and approved frequency of the inspection for each bridge, we feel that Federal Highway Administration can still adequately produce accurate information in a tabular format regardless of the inspection interval.

In the area of underwater inspection, I would like to mention some interim changes that the AASHTO Subcommittee on Bridges and Structures adopted and will be in print at the 1987 interims. These are changes in the language on underwater inspection to provide more guidance. I quote:

> Underwater inspections shall be considered for those structures where the depth of water prohibits a visible inspection of the substructure. This will normally be required at intervals not to exceed five years, unless the inspection agency has documented data to support intervals greater than this period.

At our meeting in April of 1987, we voted additional language which, as I understand, has been approved by a majority of the States, and will be introduced as 1988 interim language. I quote:

> Inspect all submerged piles for deterioration and loss of section. Special attention should be given to exposed piles in or near salt water. Corrosion of exposed steel piles may be more active at the terminus of concrete encasements on partially encased structural steel members at the water line or tide affected line and the mud line.

This language will be introduced to the States in the 1988 interims next spring.

In addition, this subject was discussed in earlier testimony and I would like to quote from the 1987 AASHTO interim specifications:

Another guideline, I quote:

> One, when submitted to a corrosive environment, structural steel structure elements should be inspected below the water line and in the splash zone by man or unmanned underwater surveillance at intervals not to exceed two years.

This is for salt water environments or corrosive environments. When in a fresh water environment, the inspection interval may be increased to maximum of five years.

So the AASHTO Subcommittee on Structures has provided some additional guidelines for bridge substructures in corrosive salt water environments.

Additional language was adopted in the 1987 interim specifications. I quote:

> Underwater inspection is the combined effort of sounding to locate the channel bottom, probing to determine deterioration and losses, and/or diving to visually inspect and measure bridge components. It should be an integral part of a principal inspection plan. Permanently submerged structural foundations and other components should be inspected when there is a reason to believe that a problem exists.

Since the area of diver training was discussed earlier, I would like to add for the record that the AASHTO Subcommittee on Structures requested at our April 1987 meeting, that Federal Highway Administration provide additional training for underwater inspection. I have discussed this issue with the Federal Highway Administration. They have that course in the state of preparation and it will be available within this fiscal year—we believe approximately next summer—to be exported to the States.

It is a three day course on bridge inspection, which will concentrate in the area of training engineers, inspectors, who will be either conducting the underwater inspection or directing divers who will conduct the inspection. So that training will be available to the States sometime in 1988 calendar year.

On the issue you of bridge inventory maintenance, Mr. Chairman, I would like to remind the members of your subcommittee that only a portion of the Nation's bridges are owned and operated by the States. In several States it is less than half. This issue has been discussed earlier. However, most bridges on secondary and tertiary roads, and within municipal boundaries are under the ownership and operating responsibilities of counties, even though they may be located on a federally aided system.

Many bridges on functionally high level systems are under the control of toll authorities, as you know, and has been discussed earlier. They are also not under the direct responsibility of the State transportation agencies.

However, the Federal Highway Administration looks to the, as do member states exclusively for bridge inventory information, and for enforcement of posting and closing recommendations. The only vehicle that most States have to enforce this compliance is the ability to withhold Federal funds.

We feel that because of this non-ownerhsip of a large majority of the structures in many States, it will be difficult for many of our members to comply with the 90 day limitation on updating the inventory. As we stated, we feel 180 days may be more attainable.

On the subject of inspection data supplied by Federal agencies, this is in the same area as inspection data submitted by local agencies, cities and counties. Federal bridge owning agencies vary in their degree of compliance with Federal bridge inspection reporting requirements. Like other things, the compliance level in part are a function of the attention given the issue.

For example, the State of Tennessee this last year, in response to a less than 50 percent compliance from Federal agencies, placed heavy emphasis on a vigorous program, and their rate of compliance by Federal agencies is now—a rate of non-compliance is in the five to ten percent range.

The issue of impact of bridges built in the 1950s and 1960s has been discussed in earlier testimony. We have submitted a substantial amount of written information on the subject, needless to say. The result of the Federal interstate highway program increased bridge construction in this country in the sixties, especially in the area of steel bridges. Twenty-five to thirty years is the time when problems will begin to surface, so I think we can assume there will be an increase in the number of bridges that will need maintenance, rehabilitation or replacement.

The Federal Highway Administration has completed a demonstration project and they have a large amount of data available on this subject and projections of the cost for the next 20 years. They could make that data available I am sure.

The subject of preventive versus corrective maintenance, this is a key issue. All inspectors are always on alert for maintenance problems. But really an effective maintenance program must be based on a sound management philosophy by the individual owner agency, and I mean by that, a regular painting program, cleaning of deck joints, bearings, et cetera. Learning from experience, building in redundancy.

I could cite an example in my own State. After the collapse 20 years ago—we have a major bridge that was erected in 1927, a similar type design with I bar members. We went in and placed a third member to build redundancy into the bridge so if there is a failure of one member it wouldn't upset the joint. I know other States have done the same thing.

When discussing maintenance, I think it needs to be pointed out here that the Federal bridge program does not now fund maintenance of any sort. No Federal moneys allocated for maintenance. It is allocated for replacements and rehabilitation. I think that is the root of one of our big problems here. When the jurisdiction owning a bridge has a funding problem, there is a tendency, which has brought out in earlier testimony, towards minimizing maintenance activities and concentrating on obtaining Federal replacement of rehabilitation funds.

I would like to mention, since the subject was discussed earlier, the post-event inspection, since the State of California was mentioned, and we are in a high seismic zone, we do have teams who respond immediately after a major event, whether it be flooding or a seismic event. They respond within hours, and then a design team goes out within a day to the site. I am sure you will find that the States that have good maintenance programs have the same type of response teams.

It is different sometimes to differentiate between preventive maintenance and corrective maintenance. However, we will conduct bridge inspection programs inevitably lead to both kinds of activities. It is the AASHTO philosophy and the very reason for AASHTO's existence, is to develop design standards in the first place, which reduce the need for preventive maintenance and/or further maintenance costs. Certainly, if we look at past experiences and improve our detail through research and observation of not only failures but details that give us problems, we can improve design. That is our intent, that is why we manually modified the design codes.

Thank you, sir.

Mr. CLINGER. Thank you very much, Mr. Roberts. I think you have given us some very good food for thought. I am particularly interested in exploring that view of everybody on the Maintenance Rehabilitation Committee vehicle.

Mr. Burns.

Mr. BURNS. Thank you, Mr. Chairman, members of the committee and Congresswoman Johnson. I appreciate the opportunity to appear before the subcommittee to speak to the matter of bridge safety inspection and bridge safety in general.

Sadly, we learned from the tragic events about our gross errors and too frequently we don't learn in between times. We have learned a lot in Connecticut from our experience with the bridge, and I think we have learned the lesson well. There was a record from the inception of the Federal Highway Bridge Inspection Program, a record of excellent ratings of Connecticut's bridge safety program. Throughout that whole period of time, from the collapse of the Mianus, it didn't take an awful lot of insight to come to the conclusion that something was grossly wrong when a bridge is rated good, and a section of it collapses.

One of the first things in addition to restoring the bridge to operation that we undertook was, with the assistance of an outside consulting firm and our own internal staff, a complete review of our practice and procedures, our staffing, our training, our equipment, just what our bridge inspection program was all about and how it was being conducted. The report concluded with 36 recommendations, all of which have been implemented as rapidly as possible. These include increased inspection crews, increased levels of training, the addition of six bridge engineers to the inspection unit, supplementing the inspection teams with contract engineers to assist them with the 600 or 650 more complex bridges in the State of Connecticut, both on their regular biannual inspections, and that required, now in Connecticut, 10-year inspections which is more extensive, including such non-destructive testing as ultrasound and the use of other devises.

Connecticut has about 3600 bridges in the state highway system and about 1200 bridges in our local system that the Connecticut Department of Transportation is responsible for inspecting. At the time of the collapse of the Mianus, of the 3600 bridges in the state system, approximately 580 were rated either poor or fair by the rating system.

Subsequent to that collapse, in Governor O'Neil's 10-year transportation improvement program, there was provided to the State a billion dollars to improve, to rehabilitate State bridges and $340 million for local municipalities to improve those bridges. We have completed rehabilitation of 400 bridges in the State system and the balance of those rated poor and fair at that time will be completed before next calendar year is over.

Subsequent to that time, an additional 300 bridges have been rated poor and are under design, another 400 have been rated as fair. We expect that within three calendar years from now, all 3500 bridges, except those major bridges scheduled for replacement which are under way, three I believe in the State, but all bridges in the State system will have a rating of at least good. It is at that time, actually it is now that the preventive maintenance is so critical to prevent those bridges after having been rehabilitated at such a cost from deteriorating again.

We are concerned about the availability of resources as they are necessary. We experienced a period of time in Connecticut of some 12 years of austerity and the first thing to be cut was maintenance in all aspects of State government. It was during that period of 12 years, when the highway system in the State of Connecticut and the transportation system generally deteriorated to an extent that was really bordered on the disastrous, and in fact we faced disaster when the bridge collapsed.

We don't agree with the relaxing of the two-year requirement on bridge inspections, not even for a new bridge. We have discovered problems on new bridges a year old. While we require an inspection before the acceptance and opening to traffic, things do happen to it, unforeseen things, and I don't know of any expert in the world who can tell me what the fatigue life of any piece of steel is. Until they have a method of doing that, then I don't know why we should relax any standards for inspection particularly in terms of frequency, also in terms of the depth of that inspection.

In Connecticut we inspect every bridge every two years and any bridge that is weight posted is inspected every six months and others with particular problems, until the problems are corrected they are inspected more frequently, some once a month. Six bridges in the State are inspected that frequently.

The Niantic River bridge is a swing bridge on a particularly busy road in a critical area in the State, is inspected on a regular weekly basis. We now have funding with the assistance of the Federal Highway Administration to replace that bridge and it will be advertised for replacement within a matter of two months.

Underwater inspections we do every two years also. We do it by contract engineers now. We don't engage our own divers any longer. A lead diver is required to be a graduate engineer and the individual, the supervisor of the crews working for us is required to be a licensed professional engineer in the State of Connecticut, so at least one of the two persons diving, doing the inspection is a graduate engineer and their supervisor is a licensed professional engineer in the State of Connecticut.

One of the requirements that we have imposed on our bridge designers and on our bridge safety inspection people is that during the course of design, the bridge safety unit of the department is involved in that design so that their input is required to determine the location and frequency or number of cat walks or ladders, the size and location of the doors into box girders, safety wires for beam walking and accessibility of joints and bearings so that when the bridge is constructed, it is as accommodating as possible to the bridge safety inspectors.

The qualification of personnel is proposed rule 650.307. We would support the alternate minimum qualifications for bridge inspection leaders. In our training program for bridge inspectors now, previously where it was a four-day course every three years, it is now a mandatory four- to five-day course every year and the Federal Highway Administration makes available a special course such as their course on inspection of fractured critical bridge members, inspectors are required to attend those training programs also.

We have no problem with the recommendation for updating the inventory every 90 days. I suppose that is because our inventory is up to date. I assume that some States might require more time until they can develop a computerized program that enables them to update it on a regular basis.

The only problem we have with posting load restrictions are some municipalities are a little lax when we notify them, but we have a follow-up procedure now that includes release of the notice to the press and we find that the posting goes up quite quickly when we do that. There are no Federal bridges in Connecticut under the sole jurisdiction of any Federal agency.

I might also add on this matter of local bridges, Connecticut does not have a complex form of government. There are only State and local governments. We don't have counties to contend with, so we have a simpler problem than other States in dealing with those matters. Now that our rehabilitation program is under way, the preventive maintenance program is beginning to pick up the same head of steam and we fully expect that with the continuation of resources—in our program, the governor re-established, with approval of the general assembly, a dedicated transportation fund with programmed tax increases, gas tax increases, license fees and things of that like, all motor-vehicle-directed revenues are now directed to a transportation fund to be used only for transportation purposes and those increases necessary to finance it are put in place in that program already.

Gentlemen, that concludes my testimony. We have submitted the prepared copies as requested. I will be glad to respond to any questions.

Mr. OBERSTAR. Thank you very much, Mr. Burns. We appreciate your response to the questions raised by the subcommittee and your entire presentation.

Mr. Mladinov.

Mr. MLADINOV. I have George Christian with me, who heads up our bridge inspection program, who can respond to questions.

We appreciate this opportunity to appear before the subcommittee and to speak of our experience and views on bridge inspection and bridge safety. It is a matter of great concern to the State of New York Department of Transportation as well.

You specifically asked that we address the circumstances surrounding the collapse of the Schoharie Creek bridge. The collapse occurred without warning during a major flood that exceeded the maximum rate of flow that had been anticipated by the bridge designers. The bridge had previously withstood an earlier flood, however, that exceeded the April 8 flood and experienced an earlier flood of greater magnitude without any seeming adverse effects.

Shortly after the collapse, the thruway authority retained a firm which specializes in investigations of engineering failures to analyze the collapse of the bridge and to issue a report on the probable causes. The firm's preliminary report was completed in June so its results could be used in guiding the design for the replacement bridge, which is being designed differently and with different provisions in the creek.

The firm's final report should be completed and released very shortly. The firm's general conclusion is that the collapse occurred because of extensive undermining due to scour under one of the piers located in the stream bed. The piers were on footings founded at a relatively shallow depth on a hard compacted glacial till material characterized by the consulting soils engineer investigating the collapse, as soft rock. The design called for riprap for the protection of the piers in the water, but there is some question whether the riprap was placed in accord with the intent of the original design.

In considering the collapse, I should note that the New York State Thruway Authority is an independent public benefit corporation independent of the State Department of Transportation. Comment has already been made that in many cases the States do have such authorities. New York probably has more such independent authorities than any other state.

The State DOT doesn't have jurisdiction over the Thruway Authority, but for purposes of bridge inspection, the authority has voluntarily agreed to inspect its bridges following the provisions of Federal law and regulations and report the inspection results to the State DOT. This is done voluntarily, and I should add that the Thruway Authority has its own manual for bridge inspection and does not follow the State's manual or do all of the inspection procedures that the State requires, nor were the inspectors required to have the same qualifications that the State requires, which exceed the Federal requirements for qualifications.

All of the authorities in the State of New York, while they have no legal obligation to do so, are voluntarily inspecting and reporting the results to the State DOT. However, it is the State that would be vulnerable to a withholding of funds if there is a lack of compliance in reporting, so the situation is going to be addressed by State legislation that will mandate the inspections to meet the standards established by the State DOT as well as required by the Federal Highway Administration.

As a result of the bridge collapse, the Department of Transportation has made a number of modifications and additions to its inspection procedures. For bridges over water bodies, the inspections are now scheduled specifically for periods of low water. That was not being done before. The inspections were being scheduled without regard to the level of water in the streams. Now they are scheduled for periods of low water in order to permit maximizing of the ability to visually inspect the underwater elements.

It also permits better documentation of the stream bed characteristics and the profile of the stream bed so as to detect possible erosion and scour. The ability to do this during low water, also minimizes the need for follow-up diving inspections. If the footings or foundations are under water and therefore not visible, a follow-up diving inspection is required.

Our procedures now call for the rejection of inspection reports if they do not conform to the above criteria. I might point out that the Thruway Authority's inspections of the Schoharie Creek bridge did not meet those criteria. They had indicated that the underwater elements were not visible and there was no probing of the underwater elements as is required by the State DOT manual, nor were there diagrams of the creek bed taken at any time by the Thruway Authority for the Schoharie Creek bridge.

For all bridges over water bodies, we will now be making a separate hydraulic evaluation including consideration of possible changes upstream or downstream that might affect the flow of the water past the bridges since the bridge was originally designed and constructed.

In the case of the Schoharie Creek bridge, there was reason to believe that changed upstream characteristics did modify the flow in the stream at the location of the bridge. Construction of a dam and a release structure upstream significantly modified the stream flow characteristics. The hydraulic studies will compare the current and currently predicted water flow to those used in the original design.

Immediately upon flooding conditions we now have undertaken and implemented a program of emergency checks of every bridge within the flooding areas. These are, in our parlance, called profile checks. They are undertaken to detect if there has been or is any movement to the bridge as a result of the flooding. That was noted earlier in the testimony as a relatively easy item to detect and we immediately do that while the flooding is under way. If there is any indication of any movement, the bridge is immediately closed.

I might point out that we do have a complex set of local governments in the State of New York. We are undertaking the inspection of all bridges, whether they are state bridges or local bridges, as a result of Federal or State legislation that ultimately made the State DOT responsible for all bridge inspections when earlier experience indicated that we could not rely on local governments to carry out the program.

We do not have the authority to close local bridges, but we do have the ability to call upon the state police to close local bridges if the local governments do not do so. Following any flood, we make re-inspections of the piers, footings and foundations of the bridges in the flood areas to determine whether there has been any erosion, scour or other damage that should be corrected. This applies to all state bridges as well as local bridges.

While we were making these improvements to our inspection program, nonetheless we were and continue to be justly proud of our bridge inspection program but we recognize that what is good can always be made better. We believe we are doing just that and we will continue to do so.

With every bridge collapse, whether in New York or elsewhere, we learn from that experience and we apply the results. We did that immediately after the Mianus River bridge collapse, when we then took immediate actions and longer term actions for bridges of similar design. As a matter of fact, we had identified the potential for such failure and had instituted actions for pin and hangar, non-redundant bridges before the Mianus River bridge collapse. However, we had not completed that corrective action for all such bridges in New York at the time of the collapse in Connecticut.

We have, as I noted, our own bridge inspection manual which is much more detailed and complete than the Federal manual, and we have a much more detailed inspection program than the Federal form that is used. While we recognize that the Federal Highway Administration is considering a change in their form for reporting inspection results, we believe that our manual and our provisions, being far more detailed, are far more reasonable for carrying out bridge inspections and give a much better picture of real conditions than is possible using the Federal forms and the Federal manuals.

It was noted earlier that there is new technology that should be applied and mention was made of snooper trucks. We have a fleet of snooper trucks. We also use ultrasonic devices. All of our crews are equipped with them. They have boats. They have a whole set of instruments including the necessary vehicles and other technical equipment that is useful for that inspection requirement.

We also equip our crews with probes to permit them to probe under the foundations and the piers to determine whether there has been scour, whether that scour hole may have been filled in with softer material so that even under visual inspection, there may not be a scour hole but there is lack of support if the material is soft, having replaced the original material.

Detailed underwater inspections by divers cover the entire state. Diver inspections had earlier been carried out on a selective basis, individual bridges being selected because of the particular conditions or age or water conditions. More recently we have put the diver inspections on a regular basis.

As for the proposed Federal Highway Administration's new rulemaking on inspection standards, which suggested that maybe variable frequencies would be appropriate, our comments to that proposal indicated that we would not object to such possible modification to the current requirements but we pointed out that New York State probably would not choose to exercise the longer frequency since the State of New York has a very large and old bridge population and our bridges face some of the most severe environmental conditions in the country and we are required to use frequent and heavy de-icing salt applications.

Many of our bridges are stream crossings. Our streams frequently carry heavy flows of ice and heavy spring run-offs. It exposes the bridges to repeated high-stream levels and potential embankment and stream bed erosion or scouring. Under these kinds of conditions, we simply would not be comfortable increasing the maximum interval between inspections.

The Federal regulations proposal, however, did not mandate that States apply it; it would be optional. Our choice is not to opt to make the change.

In our response, we recognize that conditions in other states might make it possible to call for a longer inspection interval and we recognize there may be certain types of bridges which are less susceptible to deterioration and failure. We didn't feel we had enough knowledge and a long enough history and research to give us a base for making a change in the inspection cycle. We pointed out that we have many bridges for which we have a more frequent cycle of inspection.

As Mr. Burns pointed out, depending on the condition, you can go to weekly, sometimes daily inspections. During flooding conditions, we have placed a 24-hour-a-day watch on bridges that we feel are vulnerable, even if they show no movement. Inspection is being varied but with no longer than a two-year cycle.

With regard to the suggested five-year diver inspection interval, we felt that that might very well be appropriate, particularly in terms of the frequency, but we suggested that if there is going to be a two-year inspection cycle, which we would follow, it would seem more appropriate to use factors of two for the frequency of diver inspection so that you have diver inspections taking place at the same time that regular inspections are taking place.

You asked that we comment specifically on what impact we thought the oversight and safety of having such a new inspection frequency implied. We wouldn't expect an impact in New York since we would continue to use the two-year maximum, and it is really questionable how it might affect things nationwide, because we are not in a position to know whether the states would opt to make a change, much less how the Federal Highway Administration might act on any plan submitted by the states for a variation in the cycle frequency.

We had given consideration to identifying those bridge elements that might be more susceptible to deterioration or failure and how that might give us an opportunity to limiting some of the inspections only to those elements. However, in considering the amount of time that is consumed just in getting the crew to the site, setting up the equipment, controlling traffic, getting the snooper truck in place, getting the people into the structure, the increment of time to inspect the remainder of the bridge is so little that we felt it wouldn't be worth limiting some inspections only to the more critical elements of the structure.

We have more than 12,000 highway bridges that span rivers, lakes and streams. In many cases, the low-water levels during certain times of the year permit inspection to be made without divers. However, we do have diver contracts under way right now inspecting all bridges that are not inspectable by normal inspection methods.

As for bridge loadings and postings, we have the problem that with many of our bridges being under the control of local agencies, we are not in a position to force the postings.

However, we believe that the threat of withholding of funds, both State and Federal funds for local bridges, may bring about voluntary compliance, and we also have the ability to call on the State police to close the bridge if there is lack of action by the local officials.

My prepared statement goes into the load rating system that we are applying and the number of bridges that are involved in some length, so I will not go into that here.

The issue of Federal-agency bridges is not a problem in New York. There are only eight Federal bridges in the state, and the agencies involved have agreed to submit inspection data in order to comply.

A comment was made about the large block of bridges that were built in the 50's and 60's, and in the case of New York State, it was primarily in the 60's.

Those bridges are approaching the age when they are going to be subject to major rehabilitation work. We had about 2200 state bridges alone built during the 60's, so we know that that very large block is now at the point of requiring work, and that is showing up in our inspection results.

We had anticipated that we would be ending up with an increasing number of bridges becoming deficient each year, and that is, in fact, what is occurring. Despite the very, very large capital program and maintenance program that we are carrying out, we nonetheless are ending up with more bridges deficient each year than we had before.

A comment was made about the fact that maintenance had not had the attention that it previously had. That was particularly true when looking at the real value of the dollars spent on maintenance.

The erosive effect of inflation, in particular, meant that we could accomplish far less with our maintenance dollars than we previously had been able to.

Thirty-seven percent of the State-owned bridges in New York are rated deficient at this point, although, only 89 of those are in the most seriously deficient category. Obviously we put emphasis on the latter.

At current levels of funding for bridge maintenance, rehabilitation, and replacement, and current estimates of the rate of bridge deterioration, and of inflation, our computer models predict that we will have not 2875 that are deficient, as we have today, but over 3400 deficient bridges in 1992. As a result, we have proposed a program and financing actions for the legislature to consider, and they have it before them for both our capital and maintenance programs for bridges that could reverse this direction and dramatically reduce the number of deficient bridges below today's level by 1992.

Heavy emphasis is put on preventive maintenance and not only on the capital program. The preventive maintenance program would be aimed at those bridges now considered as non-deficient, being fully adequate, but addressing those minor elements of deterioration that the inspection identifies that can be addressed today so as to avoid serious deterioration tomorrow. And we feel there will be a long-term payoff for that kind of approach over and beyond the corrective maintenance for those bridges that are already deficient, but do not require replacement.

Before finishing, I believe I should comment on the issue of the distribution of Federal funds for the bridge program. We were distressed with the 1987 act probably more because of the 20 percent reduction in Federal funding for bridges compared to what we were getting before than anything else, and in the distribution formula, which is based upon the reports by the Federal Highway Administration on the relative needs of each state for bridge rehabilitation funding. Those figures show that New York should be getting 18 percent of the national funding.

However, the provisions of the act continue to carry a limitation of no more than 10 percent going to any one state. New York happens to be the only state in the country that is affected by that limitation. That means for New York a reduction of $120 million a year in bridge funding with its aging population of bridges, the Brooklyn Bridge is 100 years old, and others like that in the New York City area as an example. That $120 million which we do not get which the formula would give to us were the limitation not imposed, represents a bonus which is distributed to all the other states.

We would suggest that the Congress consider a revision in that 10 percent cap. We feel that to minimize the impact on other states that a modest inching upward take place. Inching that up to 12 percent of the national total would only result in a 2 percent decrease in the funding for each of the other states in the nation for their bridge programs.

In addition, the interstate 4-R portion does not recognize the bridge needs on the interstate system. The formula simply relates to the travel on the interstate system and the lanes on the interstate system, but not to the bridge conditions or the number of bridges or their deck area or anything else that would relate to the needs for funding.

We believe that the formula for distribution of Interstate 4–R money should be modified to include factors for bridge conditions. Nineteen percent of bridges on the interstate system nationally are rated deficient by the Federal Highway Administration.

Over 4300 of those bridges under the Federal definitions and criteria are eligible for replacement or rehabilitation. A revision of the Interstate 4–R distribution formula to recognize bridge needs would go a long way to meeting the need to create a national bridge program.

Thank you for the opportunity to testify and to make these points. We stand ready for questions.

Mr. OBERSTAR. Thank you very much.

We appreciate the testimony that all panel members have given and the very careful attention to the specific questions the committee has raised and your detailed responses to those questions.

I would like to begin on the matter of technology; how widespread, in your experience, Mr. Roberts, and the other members can comment as well, speaking on behalf of AASHTO and its member states, is the use of technology. Ultrasound has been touched upon in the panel's testimony, magnetic particle inspection, radiography, and articulated cranes for underbridge inspections, underwater inspection technologies—to what extent are states using the latest state-of-the-art, both to do better inspections and to reduce the manpower perhaps or minimize the manpower required in bridge inspections?

Mr. **Roberts**. I have prepared some comments here to respond. There is a couple of good articles that were handed to me that have been printed in the "Better Roads Magazine," which really discuss in a fairly great level of detail what many of the states do in this area, and the use of the articulated cranes and other types of maintenance inspection techniques.

Mr. **Oberstar**. If you could leave those at the table with unanimous consent the committee will include those in the record.

[Articles referred to follow:]

How

DOTs inspect to save bridges

If you're even partially responsible for bridges, you can expect serious trouble. About 240,000 of the nation's bridges, or nearly 42%, are structurally deficient. Nearly 12,000 of them deteriorated to hit that list in the past year alone.

And, if you think you'll just fix what's wrong, think again. Federal assistance for bridge rehabilitation and replacement was cut 20% this year, to $1.6 billion. Yet, we need $5 billion a year for the next 10 years to meet capital bridge needs already identified.

Another problem is that inspections, as currently mandated, often cost many times the maintenance budget, leaving even less to spend for major repairs.

Inspections are important for all types of bridges. In addition to showing individual defects, they can pinpoint the most critically ailing structures. Some states, such as New Hampshire, place these bridges on a red list, meaning that they need the most immediate attention. This bandaid approach to bridge repair is far from ideal, but it can prevent bridge collapses and save lives.

Inadequate inspection should seldom or never occur, since all bridges must currently be inspected at least once each two years. Yet, this reason was cited as a contributing factor in the April collapse of the Schoharie Creek Bridge in New York, which killed 10 motorists. In a 38-page report of the Commission of Investigation, Chairman Donald Trager said that, "while the bridge's design and construction may well have been deficient, with proper inspection and maintenance, the bridge would not have collapsed."

Kentucky is one of many states using snoopers to provide access to difficult-to-inspect areas.

How often?

Bridge inspection frequency is an arguable point. Many bridge engineering specialists, such as Hardesty and Hanover's Dick Christie believe it makes little sense to slavishly inspect all bridges each two years. Some bridges need more frequent exams, while others could safely wait longer.

Proposed changes in federal standards, if passed, will increase the maximum time between some required inspections, such as those for fairly new bridges. More time will then be given to frequent inspections for those bridges with minor — or worse — structural problems.

The regulatory change makes sense from the standpoint of budgets that won't stretch to meet the two-year mandate. Currently, inventory data shows that there are thousands of bridges that have not been inspected for three years, says William Buglass, Byrd, Tallamy, MacDonald & Lewis. Buglass reported on bridge inspection standards at a recent American Road and Transportation Builders Association conference on local transportation.

Michigan has set up a structure for inspections, depending on bridge condition, says Maurice E. Witteveen, Engineer of Maintenance. All structures listed or recommended for the bridge replacement program are inspected each six months, as are any structures with a composite appraisal rating of three or below (on a scale of zero to five) and structures listed or recommended for total deck replacement. Bridges with an appraisal rating of four or below are inspected once a year, as are movable bridges, structures with a zero paint rating under joints, culverts known to be in poor condition based on past inspections, and any other structures which the inspector believes require the attention. At least half of all state highway bridges and culverts are inspected biennially.

Connecticut, still smarting from national attention to its 1983 bridge collapse, uses the federal mandate to inspect all bridges at least once each two years. Load-restricted bridges or bridges with specific problems are inspected more often, usually every six months. Bridges with pin and hangers, without any unusual problems, are inspected annually. However, some bridges are monitored as frequently as once a month, says Robert I. Thomas, Supervisor of Bridges and Structures. Scheduling is accomplished through the use of computer sheets that identify bridges in each of eight inspection areas, giving the last date of inspection.

Colorado inspects its 3,577 state-owned bridges on a two-year schedule, says H. Henrie Henson, Staff Bridge Engineer. Its Structure Inspections and Inventory Unit is responsible for administering contracts for three consulting firms to inspect the state's 4,040 city and county bridges — also on a biennial schedule.

California varies inspection schedules, says Jim Drago, Department of Transportation. Intensive inspections are made before a new structure is put into service, and again if major geometric changes are made, or when major modifications are planned. Structures that have developed maintenance problems are given intensive inspections at intervals varying from six months to two years, depending on the intensity of the problem. Routine inspections are generally completed biennially. These are more rapid examinations to pick up obvious defects or areas of potential maintenance. Specialized inspections are completed as needed. These include hands-on examinations of non-redundant structures, fracture critical details, or other structures that have a proven history of serious maintenance problems. Other specialized inspections include those required as a result of natural phenomenon, such as high-load hits, ship impacts, fire, flood, and earthquakes. Underwater inspections are made of bridge foundations if clarity and depth of water prevents normal visual inspection.

Minnesota has mandated annual inspections of every bridge in the state — a big job, since there are 19,000 of the structures. The Minnesota Department of Highways sponsored the legislation that requires the yearly checkups. More frequent inspections are made if the age or condition of the structure warrants, says Donald J. Flemming, State Bridge Engineer.

Nevada inspects about half of its 1,128 bridges each year, and from 100 to 120 of these receive an in-depth exam, says Marc S. Grunert, P.E., Principal Bridge Design Engineer. Three graduate engineers perform inspections on all public access bridges in the state.

Wisconsin's laws require annual inspection for bridges maintained by the state, and biennial inspection for bridges maintained by other governmental units, says Cliff Benz, P.E., Bridge Inspection Engineer. Interim bridge inspections are required on bridges that have special problems.

Arkansas performs inspections to the requirements of the National Bridge Inspection Standards. The program works on a two-year cycle, with state bridges inspected during even years, and local governmental bridges examined in odd years, says John E. Hall, State Maintenance Engineer.

A two-year cycle is used in Maryland, says Geoffrey V. Kolberg, Chief of the Bureau of Bridge Inspection and Remedial Engineering. In the case of advanced deterioration, or on bridges with stresses at operating levels, this cycle may be shortened.

In Oregon, a major bridge receives a normal inspection every two years. But, says Thomas D. Luay, P.E., Structure Maintenance Engineer, every third inspection is an in-depth inspection by a special team. Resulting reports are more detailed and often lead to design or construction projects to remedy the faults discovered. Major inspections are budgeted and funded from the state's structure maintenance office, while normal inspections are budgeted at the regional level.

About 35% of Ohio's 42,351 bridges are on the state highway system. These are inspected annually by one of the state's 21 full-time inspectors, says R. L. Zook, P.E., Engineer of Maintenance. The remaining structures are examined by various other political subdivisions. At the state level, 22 bridges are considered large and complex enough to warrant special inspections. Pre-qualified consulting engineers are selected to examine these structures once each year on a three-year cycle. The consultants are required to do an in-depth inspection and evaluation on each bridge and furnish the DOT with a formal, written report complete with photographs.

Very frequent inspections are part of the routine at Indiana's Division of Toll Bridges. Although structure inventory and appraisal sheets are prepared biennially, five types of inspections are made of each bridge. Daily walk examinations are Class I inspections. These include visual checks for damage from traffic or weather, items needing repair, and inoperable lights, as well as a check for strange sounds and excessive vibrations. Class II inspections are quarterly sidewalk exams, where structural steel and concrete are checked visually. Class III inspections are annual and consist of examination of

Maintaining bridges after inspection

A guide to maintaining bridges once inspections are completed has been prepared by the National Association of County Engineers. The pocket-sized book is aimed at the foreman and the crews responsible for bridge maintenance in state, city, and township, as well as county road departments.

Legal requirements, safety, environment, judgment, and types of bridges are discussed as an introduction to the subject. But, the heart of the book includes a wealth of usable, everyday matters such as a checklist for bridge maintenance needs. Subjects included are:

- Bridge inspection.
- Signing.
- Waterways.
- Approaches.
- Substructures, including concrete, timber, steel, and stone masonry.
- Superstructures, including trusses, beam spans, bearings, and expansion joints.
- Decks, including timber, concrete, and steel, as well as curbs, sidewalks, and railings.
- Cleaning and painting.
- Culverts, including location, debris control, and inspection.

Sections on how to prepare for maintenance and how to complete it follow this checklist. Special sections are included on vermin damage and corrosion.

The 121-page, paper-backed book is just the right size to tuck into a pocket. Its illustrations provide excellent visual guidance. NACE credits the advisory committee who directed preparation of the guide — Robert Hagerty, Boone County, Missouri; Richard Lanigan, Delaware County, New York; Nabi Fakroddin, Kane County, Illinois; Arthur Tobkin, Clearwater County, Minnesota; Lloyd Roberts, Yolo County, California; and Hubert Foley, Jr., Union County, Mississippi. *Better Roads* editors commend the committee and recommend the guide to anyone responsible for inspecting or maintaining bridges. ☐

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concrete and structural steel without using scaffolding or powered equipment. A detailed check is made of abutments, piers, accessible areas of the deck, bearings, finger plate expansion devices, and framing in the bottom chord areas. Class IV inspections are biennial. These consist of detailed exams with use of a manlift or scaffolding to look at potential problem areas such as pins, pin plates, cable hangers, and T1 material. Class V inspections are made every 10 years, or as needed, says Nicholas Van Nielen, P.E., Chief, Division of Toll Bridges. These include the use of powered equipment or scaffolding to obtain access to the underside of the deck or other areas inaccessible from the bridge proper. This inspection is an in-depth field exam of all parts of the bridge. Non-destructive testing may be used to supplement the visual inspection. Additionally, emergency inspections are performed whenever life, property, or bridge traffic are in jeopardy.

In Kansas, annual inspections are made of problem structures, posted structures, fracture critical structures, and structures more than 50 years old. Biennial inspections are made of all open-span structures less than 10-ft. long. Inspections are made every four years of remaining structures with spans from 10 to 20 ft., says Dan Schefschligt, P.E., Bridge Inspection Engineer.

Two seven-man squads make up the analysis section that is responsible for safe bridges in North Carolina. These crews analyse all bridges once every two years, says Owen W. Reagan, Bridge Inspection Engineer. If posting is required, a recommendation is made for these values.

In Arizona, most inspections are completed by Department of Transportation crews. Three teams examine about 3,936 bridges, including about 800 city and county bridges. Larger, more complex structures such as arch bridges are contracted to consultants for in-depth inspection on a six-year cycle, says R. C. Brechler, Assistant State Engineer-Structures.

The underside of a bridge becomes more accessible with an overbridge snooper.

Techniques of the trade

The use of computers to track bridge maintenance problems, videotaping or other photography of problem areas, and the use of specialized equipment contribute to more effective inspection programs. Colorado is using a data base called Information Retrieval Inventory of Structures System (IRIS). The data is maintained for both state and city/county systems. Information for 87 items for each bridge is included. Consultants are provided previous inspection information on a computer disk generated from IRIS. Each consultant inspects the bridges, computes any required ratings, and then revises the disk. The disk is returned, along with inspection reports. Information from the disk is processed through a check program to assure that the inspection is complete and to flag major differences from the previous report. The revised data is loaded into the IRIS data bank, says H. Henrie Henson, Staff Bridge Engineer. The computer system also generates the Bridge Inventory Report submitted to the FHWA, the Field Log of Structures, the Vertical Restriction Report, the Bridge Weight Limit Map, the Colorado Structure Inventory and Coding Guide, and the Bridge Rating Manual.

A Bridge Management System (BMS) is being used in Pennsylvania. The system accepts, stores, updates, and reports physical and operating characteristics for all public bridges in the state. It is the resource for district and statewide management decisions, such as prioritization, rehabilitation, replacement and maintenance needs, costs, future needs, predictions, and also serves as a tool for budgeting. It provides about 20 standardized monthly management reports based on data contained in the system. Much of the information in the computerized system is related to bridge inventory structural condition and load-capacity determinations.

In Vermont, data from state bridge inspections is similar, but not identical, to information required for federal reports. The state inventory items are entered into a computer and transferred electronically into the FHWA format, says Warren B. Tripp, Structures Engineer.

Data control and management has become a very significant function of the inspection program in Washington, says C. S. Gloyd, Bridge & Structures Engineer. To meet the demand for information, data is stored in the computerized State of Washington Inventory of Bridges and Structures (SWIBS) data file. A restructuring of the computerized inventory is presently underway — to improve access to data, to develop a bridge management system, and to monitor and evaluate bridge inspection data.

North Dakota reviews inspection data using a computer program designed to analyse the findings at each site, says James R. Anderson, Bridge Inspection Technician.

Videotaping is used in some inspections in Michigan, says Maurice E. Witteveen, Engineer of Maintenance. A Reach-All inspection unit was used to provide good access for the personnel doing the filming. The method is useful in relating problems discovered to other department personnel, Witteveen says. The technique will be continued on

(Continued next page)

more critical bridges to aid the design section in preparing plans for repair.

The use of pictures is emphasized to illustrate conditions found in the field, says Cliff Benz, P.E. Bridge Inspection Engineer, Wisconsin Department of Transportation. The pictures are made part of the inspection report. Use of sketches or drawings to clearly show a condition that exists are also used.

Videotaping is used in North Carolina, including underwater taping of conditions. The films are used to assess damage and in training programs, says Owen W. Reagan, Bridge Inspection Engineer.

In Vermont, inspectors use audio as well as visual technology. The leader of each inspection team uses a dictaphone to give a verbal description of the bridge as he is making his inspection. This report is then transcribed into a written document. The report is completed in addition to completing the normal inspection form.

The Thousand Islands Bridge Authority, with its bridge system on the New York-Canadian border, pays special attention to the suspension span portions of the system during inspections, says Russell Wilcox, Executive Director. Every rivet, bolt, clip angle, and so on is checked and replaced if needed during the special inspection. Major problems are noted and brought to the attention of the consulting engineers.

Nondestructive testing techniques are used by inspectors in many states. Such methods are used in Indiana to detect flaws or cracks in steel members and connectors, says Joseph S. Torkos, Bridge Inspection Engineer. Ultrasonics, penetrants, magnetic particle, and eddy current equipment are used where needed. The department has used dye penetrants and employed ultrasonics with mixed results, Torkos says. To evaluate concrete, infra-red thermography, ground-directed radar, and X-ray techniques have been tried and look promising as non-destructive testing methods.

In Nevada, ultrasonic testing has been used on some pins in the pin-and-hanger connections, but only as a test of the method's usefulness, says Marc S. Grunert, P.E., Principal Bridge Design Engineer.

Dye-penetrant, mag-particle, and ultra-sound testing are used to detect cracks or flaws of steel members in Wisconsin, says Cliff Benz, P.E., Bridge Inspection Engineer. X-rays and acoustic emission testing have been used as well, but when performed, an outside supplier did the work.

Dye penetrant is a normal part of the field inspector's tool kit in Ohio. Additional non-destructive testing devices used include an ultrasonic thickness gage, magnetic particle device, concrete rebound hammer, and a reinforcing steel locater.

Ultrasonic testing equipment is used to inspect steel members in North Carolina, says Owen W. Reagan, Bridge Inspection Engineer. This equipment is used by a special investigation section team, specially trained in its use.

Dye penetrant, ultrasonic, radiographics, and magnetic particle tests are used in Connecticut. A D meter is used to check the thickness of the metal remaining, and cores or samples are taken for laboratory testing and dismantling assemblies.

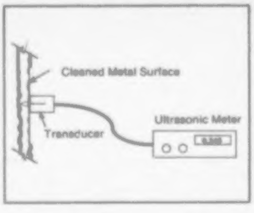
Underwater inspections are growing in importance, with attention focused more strongly in this area since the Schoharie Creek Bridge disaster earlier this year. Donald J. Flemming, State Bridge Engineer, says that the Minnesota Department of Transportation has even gone beyond the use of underwater inspections. They began taking a more critical look at both the department's inspection system and the types of footings used after the collapse. The Schoharie Creek Bridge used spread

How to inspect steel for corrosion

There are three basic methods available to determine the thickness of a corroded steel member, according to Jack R. Kayser, University of Michigan, and Michael A. O'Neil, Washtenaw County Road Commissioner, Michigan. These are visual estimation, mechanical measurement, and ultrasonic measurement. Kayser and O'Neil described the basics of the three techniques at the recent 4th Annual International Bridge Conference.

Visual estimation is the simplest and quickest method. The values are generally written on an inspection sheet, using increments of 10%. This method can be used to check the amount of paint loss or area of surface corrosion, Kayser and O'Neil say, but it is not a reliable way to estimate section thickness.

Mechanical measurement should be used on steel that has been cleaned. Some mechanical devices are more accurate than others. A ruler, for instance, can be read to a hundredth of an inch, while a micrometer can be read to a thousandth of an inch. Several readings should be taken to allow for local variations in the metal, due to pitting. Accessibility of the steel member limits the use of mechanical measurement. If measurements are to be taken at midspan, access must be provided and traffic control is needed. Such measurement also requires access to both sides of a member.



Ultrasonic thickness measuring is one of three methods that can be used to inspect steel for corrosion.

Ultrasonic measurement is completed with an instrument that costs about $1,500. The instrument must be calibrated, but its application to measuring the thickness of a plate is very simple, Kayser and O'Neil say. The method works by taking an ultrasonic thickness measurement based on the timing of a sound wave as it travels through metal. Accuracy of ultrasonics used in bridge inspections is about +/- 0.0025 in. While access to the steel member is needed, as in mechanical measurement, only one side of the member needs to be examined. This makes it easier to measure web thickness. □

footings. "We closed an additional 11 bridges as a result of re-evaluating some of the more critically deficient bridges," Flemming says. "We've identified all of the bridges in the state that are on spread footings or foundations that are unknown *and* subject to a potential scour problem." To solve this potential problem, department personnel are currently establishing hydraulic criteria necessary to forecast the probability of serious scouring, which may cause the structure to fail (such as water elevations or rate of flow).

The Indiana inspection van is equipped with a boat rack, which allows use of a small boat for probing around piers which are otherwise inaccessible, says Joseph S. Torkos, Bridge Inspection Engineer. Underwater inspections are currently being considered for a professional services contract. A trailer hitch is being acquired, which will allow transport of a boat of greater size and equipment to some of the larger bodies of water for underwater inspections, Torkos says. The department recently borrowed a boat, trailer, and depth finder with printout from the Department of Natural Resources. "This worked out well, and we hope to repeat this operation on other bridges," Torkos says.

On underwater inspections in Wisconsin, soundings by probing and sonar equipment have been made to obtain streambed profiles, says Coff Benz, P.E., Bridge Inspection Engineer. Sonar equipment that will give a tape printout has been purchased. The tape is superimposed on plans of the substructure units to check for scour and undermining. Divers are used occasionally on larger and older structures in deeper water.

Safety gear, including lines, is an important part of inspection.

Arkansas has adopted a more thorough underwater bridge inspection policy, says John E. Hall, State Maintenance Engineer. All bridges with substructure items below the water line are given an underwater inspection. Different methods are used, ranging from the use of a diver to inspecting at low water using hip boots and feeling with hands and probers.

Oregon's underwater inspections are conducted by divers working from the structure maintenance office. Two engineers direct the program and have underwater inspection duties included in their job descriptions. Additionally, five highway division employees assist during the diving season, but don't work in jobs that stipulate diving as part of their work. These qualified divers are borrowed from their normal work for three to five weeks during the season. Each inspection requires three to four divers, and the crew consists of the two full-time personnel assisted by the one or two borrowed workers.

In North Carolina, underwater work is completed by a special field team of three. Working with an above-water team, bridge decks are evaluated, movable span machinery is examined, and an ultrasonic inspection of steel members is completed.

Equipment used

When bridge inspections were first begun, hand tools were all that were available. Today, hand tools and careful visual checks are still important, but larger pieces of equipment can provide easier access to locations where damage is most likely to occur.

The biggest change has been the use of under-bridge inspection units. Only a few companies make these machines, including Paxton-Mitchell, Reach-All, Cramer, and Bronto Skylift. Paxton-Mitchell's Mark II snooper is the most popular unit. In Arkansas, it is used to thread through truss members on smaller bridges, providing access to problem areas. This unit comes in platform or basket configurations. The snooper gives more than 4,000 sq. ft. of under-bridge coverage. It has a 360-degree main turret turn, plus a rotating sweep arm. It operates from one lane of the road. Reach is 40 ft. across, 47 ft. below, and 43 ft. above bridges. Curb weight is less than 52,000 lbs.

The Cramer Bridge Prober, which reaches under a bridge 32 ft. from the top of the deck, and which can be extended 63 ft. horizontally under the bridge, is used on major Arkansas bridges, says John E. Hall, State Maintenance Engineer. A Genie Lift is mounted on the end of the inspection platform.

In Ohio, two Paxton-Mitchell snoopers are available, when requested by inspectors, to inspect hard-to-reach areas. Alabama's Super Snooper, made by the same firm, is rotated around the state, so that each inspector can use the device on bridges that require it. Other states reported snooper sharing as well. The Super Snooper is used by Kentucky, in addition to its Mark II, says George W. Asbury, P.E., Engineer Director, Division of Maintenance. A third unit inspectors use is a DFM Bridgemaster.

The new Reach-All unit is being used by some states, including Nevada and Michigan. The unit is also part of an FHWA demonstration project to evaluate inspection units. The machine can extend a platform 60 ft. under a bridge. It has four booms. The first can move 17 ft. The second can reach under girders as deep as 21 ft. The third can reach to the center line of a 116-ft. wide bridge. And, the fourth boom goes under 20-ft. girders and runs up between girders.

(Continued next page)

"The Bridgemaster provides us with the ability to access virtually every square inch of the super- and substructure with only minimal traffic impacts [single-lane closure]," says Marc S. Grunert, P.E., Principal Bridge Design Engineer, Nevada Department of Transportation. "The vehicle also has the versatility to be operated from beneath the structure as a relatively flexible lift device."

Michigan leased the Reach-All unit, and finds it extremely useful for inspecting areas under bridges which cannot be accessed by any other means, says Maurice E. Witteveen, Engineer of Maintenance.

Trucks and cranes are fitted with baskets and, sometimes, department-made platforms, to use during inspections. Scissor trucks are used by some states, including California.

New Hampshire uses electric or pneumatic spider staging on complex or weight restricted structures, says Andrew J. Lane, P.E., Administrator, Bureau of Bridge Design.

Wisconsin reports using sounding with a hammer, chain dragging, thermography, and delamtec to check delamination in concrete decks. Cores have also been taken for checking the soundness of concrete, says Cliff Benz, P.E., Bridge Inspection Engineer. To check the soundness of wood, inspectors have completed wood borings and sounded with a hammer.

A sounding or chipping hammer is the primary tool of the inspector in Ohio. Additional tools and equipment includes ladders, a plumb bob, a 6-ft. ruler, flashlight, magnifying glass, 2-ft. level, spray paint, surveyors' rod for probing around footers, safety belt, hardhat, and gloves, as well as non-destructive testing devices already mentioned.

A small aluminum row boat and an extension ladder are required tools of inspection in Vermont, in addition to many of the others already cited.

Washington's list includes geologist rock hammers, brace and bit, ⅝-in. 0 treated plugs, red and yellow survey flagging and hub tacks, paint scrapers, wire brushes, whisk brooms, pocket knife, pocket tapes and/or folding rules, 100-ft. cloth and metal tape, vertical clearance rod, calipers, binoculars, 35-mm and Polaroid cameras, inspection mirrors, a hand level, flashlights, contact thermometers, plumb bobs, tilt meter, machete, crack comparators, short chains, ladder, lead lines, personal safety gear, hip boots, and waders.

Connecticut uses radio equipped vans. Fiberglass ladders are used to inspect bridges over electrified rail lines. An acoustic crack detector and the magnetic crack definer developed for the FHWA are also used.

How to document underwater inspections

Documentation of underwater inspections is especially important, because divers rather than engineers are sometimes used to complete the work, and may not be aware of many engineering problems. Even when an engineer-diver completes the work, documentation provides a needed reference point for making decisions about maintenance.

Improvements in underwater documentation include color photography and video — at an economical cost — says Thomas J. Collins, Collins Engineers, Chicago. Black-and-white and color 35-mm photos can be made of underwater conditions. Most normal cameras can be used in underwater cases made of clear acrylic plastic sealed with rubber gaskets. Collins reported on underwater documentation at the recent 4th Annual International Bridge Conference.

Waterproof 35-mm cameras have also been specifically designed for underwater use. Cost, including a wide-angle lens and underwater flash, is about $2,000.

Lighting is necessary to obtain good documentation. The flash unit should be placed to the side so that light does not reflect directly into the lens. Two light sources lower the intensity. A diffuser can reduce localized intensity of the flash. Artificial light is needed even in fairly clear water where natural light penetrates. This is so, because the water filters and absorbs colors and key details and contrast can be lost without the lighting.

Most films can be used in underwater work. By selecting one specific film, such as ASA 100, however, the diver will more quickly learn what sort of lighting to use.

Photos should be taken as the inspection progresses, rather than waiting until the end of the project, Collins says. This allows review of initial photos and adjustment of lighting and other factors before all of the photography is completed.

It is useful to provide some color and size scale when taking photos underwater. For instance, a notation may be made on a strip of duct tape or another object. This is photographed as a reference point, allowing the processing technician to adjust color.

When water is extremely turbid, Collins says, a clear water box may be used. This is made of clear acrylic plastic which can be filled with clean water, through which the camera can be aimed. The box is pressed against the subject and displaces the dirty water. Various sizes of boxes can be built, depending on the objects to be photographed. Electronic strobes can be mounted on the sides of the box to provide lighting.

Underwater video equipment has also improved, Collins says. Clear acrylic plastic housings are available for many of the video camera-video recorder combinations. These may be used with both camera and recorder below the surface, or with the recorder used above water. In this latter case, a monitor is used and an inspector above water records information about the inspection. Underwater video cameras with recorders range in price from $2,000 to $50,000 or more. The more expensive units include special equipment to add typed notes to the video tape. □

Arizona uses a 0.75-t. truck equipped with an enclosed utility bed and a two-way radio, says R.C. Brechler, Assistant State Engineer-Structures. The truck carries a 15-ft. aluminum breakdown-type ladder, a 35-mm camera, a direct-reading clearance rod, binoculars, transit level, chain drag, numerous hand tools, and safety equipment.

Training inspectors

The FHWA's training course based on the *Bridge Inspector's Training Manual* is the standard training provided for inspectors in many states. In Ohio, inspectors are primarily technicians rather than engineers, says R. L. Zook, P.E., Engineer of Maintenance. The state has 21 full-time inspectors to inspect its 14,612 bridges on an annual basis. These full-time inspectors are assisted by construction inspectors and engineers-in-training on an as-needed basis. The average bridge inspector is expected to examine six bridges per day. An inspection form with 120 items to check is used. The department offers training courses every two years. These are given at six different locations around the state, and are free-of-charge to anyone who is interested. Those who attend, Zook says, are generally ODOT personnel, FHWA personnel, county engineers, city engineers, consultants, and so on. FHWA-sponsored courses, such as one for inspection of fracture critical bridge members and another covering non-destructive testing methods for steel bridges, are also used. The state is considering use of a certification program for bridge inspectors, and may develop in-house bridge inspection training video tapes.

Alabama uses in-house training, with classes available each year. State inspectors attend every year, says T. L. Cain, Maintenance Engineer, while county inspectors attend every other year. The state participates in FHWA-sponsored courses as well. A bridge certification program was started recently. The requirements parallel AASHTO requirements, Cain says.

All divers used in Oregon's underwater inspections are trained bridge inspectors, says Thomas D. Luay, P.E., Structure Maintenance Engineer. Underwater inspections are performed on about 125 bridges per year.

In Montana, the manager of the inspection program is responsible for training inspectors, as well as his other duties, says Norman H. Rognlie, P.E., Chief-Bridge Bureau. Inspectors are generally drawn from bridge construction project managers, who then pass a two-week course in bridge inspection. They must also have more than five years of bridge experience. A manual for inspectors was developed by the DOT, giving explicit instructions to rate the condition of the state's 4,723 bridges.

Underwater inspections are important, and in many states they are mandatory where bridge piers and abutments are in the water.

North Dakota's State Highway Department has also developed a bridge inspector's manual, says James R. Anderson, Bridge Inspection Technician. This is used as guidance for crews working in the field, and serves as an aid to uniform condition rating of structures. An annual seminar is held for all field employees to refresh their thinking and explain any new changes in field operations, Anderson says.

The State Bridge Engineer, Charles H. Wilson, P.E., provides the training for inspectors in Wyoming. This job is getting bigger, since off-system bridge inspections were recently moved in-house. Teams of inspectors will travel the state, primarily by inspection van, to perform their duties on off-system as well as state bridges.

What's ahead

The chief change in bridge inspections for many [illegible] the addition of [illegible] bridge management system. This system will include all aspects of operating and maintaining a bridge, with inspection serving as just one module of the program.

"The systems are on the way in," says William Buglass of Byrd, Tallamy, MacDonald & Lewis. "They will probably be required to obtain funding in the future."

In another new step, the FHWA has a demonstration program which will allow inspectors to work with a diving team to learn something about evaluating techniques to use underwater. This may become more popular, as the use of underwater inspection becomes more important.

Proposed FHWA standards may require the states to maintain special lists of inspection findings, actions, and so on for specific bridges with underwater members, unique features, fractured or critical members, and so on.

Certification of bridge inspectors is also [illegible] projects [illegible].

An [illegible] fact, a [illegible] says that if bridges are not posted, and a short-term plan to correct deficiencies discovered in inspection is not filed, the local governmental unit could lose its federal funds — for all purposes. ☐

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Better ways to inspect

Inspection costs could be reduced or the money better spent by changing the inspection cycle requirements, says Richard Christie, a partner in Hardesty & Hanover, New York. The 100-year-old firm is one of the key consulting engineering firms in the country specializing in bridges. It was picked to help find what went wrong on numerous bridge collapses — from the Silver Bridge in West Virginia in 1967, to the Schoharie Creek Bridge collapse this year. In between, the firm's engineers also consulted on the collapse of the Mianus River Bridge, which collapsed in 1983 in Connecticut, and on California's Bryte Bend Bridge, which was a failure during construction.

Hardesty & Hanover has inspected bridges throughout all of its years. Of the firm's 382 projects, 77, or 20.2%, included inspection procedures. Interestingly, of the 159 projects undertaken since the Silver Bridge failure, 55 or 34.6% have included inspection procedures, underlining the trend toward more inspections since that time.

Better inspection cycles

Christie's desire for a different time framework for inspections echoes the feelings of many specialists in the industry. "I personally disagree with the FHWA's requirement for two-year cycles on bridge inspection," Christie says. "They were about to increase the cycle time before Mianus fell down. Then they changed their minds.

"Connecticut hired us in conjunction with another firm to do a review of their inspection procedures, and we came up with a longer time interval between inspections. We also came up with a staggered type of inspection — a major inspection on a 10-year cycle, and a lesser inspection on a three and one-third-year cycle. We think this is more reasonable for most bridges.

"I think the money spent on these two-year inspections is completely out of proportion to the value. It's more a paperwork end product than a technical assessment of the bridge. Whether it's accurate or not doesn't seem to matter. If your inspector's half blind, that's of little concern. But, the paperwork's got to be in."

Another change that's needed is the timing of inspections for new bridges, Christie says. "To inspect a brand new structure on a two-year cycle, unless it's got some kind of unusual problems, is unreasonable. [Inspection cycles] should be based on the *age of the structure*, its complexity, and its condition.

"The American Bureau of Shipping has progressively tougher inspection requirements as the ship gets older. This kind of philosophy is what should be put into highway department inspections. Inspections of certain structures could be extended from two years to three, or four, or five. Other bridges might need inspection every six months."

> *"Eyes are the [best] inspection tool."*

Better inspection standards

Bridge inspection standards need to be developed by bridge specialists, Christie believes. "After the Silver Bridge collapsed," he says, "[the FHWA] had a very knowledgeable person who was the father of many of their welding requirements. But, he was a metallurgist and a welding expert. He wasn't a bridge engineer. He tailored many of the new design requirements to the welding/metallurgy solution rather than using the broad solution encompassing all facets. He wanted to solve all of the problems with the welding/metallurgy approach, which is one way to do it. But, it's not necessarily the economical way. It's a narrow-minded way."

The slavish use of checklists is one of Christie's pet peeves. "After Mianus, one state agency developed a multi-page checklist to inspect bridges with hanger links. They missed the most important item in the inspection.

"Crews were sent out to inspect all of these bridges, but they had to go back two weeks later and do them all again — because the author of the checklist missed one of the most obvious and easy things to check. This is the problem with checklists. On unique structures, the critical item may be missed with a checklist. It takes the experienced eye to pick up problems."

Eyesight the best tool

An engineer's eyes used correctly are Christie's favorite inspection tool. "The most important factors in bridge inspections are the qualifications and talent of the inspector," he says. "Today's training is aimed at subprofessionals, which is what many states use. It's a cookbook type of training. But, you can't teach an inspector judgement. And, on all but the simplest structures, it's the judgement that counts.

"The inspector has to look at every piece of the bridge with engineering judgement. You can't just whitewash it with a checklist. You can go through the checklist and still miss a bad part.

"We don't use much high-tech — videotaping, infra-red photography, and so on. We look at the bridge and see what's there. We see what's left under the rust and the pigeon droppings and all of the other crud that piles up on these structures.

"The biggest problem when inspecting a bridge is to keep the inspectors interested enough to stay alert — particularly when they inspect the same bridge on a two-year cycle. You can be lulled by the fact that you've been there two or three or four times before."

Eyesight is the best way to check initially for hairline cracks, as well, Christie says. "Nobody can afford exotic methods to check an entire bridge for hairline cracks. It is worth noting that the minute crack which triggered the [illegible] of the Silver Bridge [illegible] where [illegible] tify certain [illegible] pect areas [illegible]

The most [illegible] owners can [illegible] clean and paint [illegible] you sandblast the [illegible] dirt, rust, and old paint [illegible] you find the defects you might [illegible]

bridges

otherwise locate," Christie says. "You can't hand clean a bridge during a routine inspection — you haven't got that much money or time. And, hand cleaning's probably not good enough — you have to sand blast."

There are a number of key inspection points that deserve the attention of that careful pair of inspector's eyes. "On older, early-vintage welded bridges, there is bad geometry on many member intersections that are places to look," Christie says. "Any place that collects dirt, that collects water, or has high stresses or combined stresses are targets. Complex stress patterns due to connections of diaphragms and cross beams are other points, as are locations under curb lines, where water leaks through the deck, and under scuppers that don't have long enough pipes. Another area to check is any location where pigeons or other birds roost."

The firm subcontracts underwater inspections and uses primarily licensed professional engineer-divers. "They don't cost much more than an unlicensed diver," Christie says. "You're at their mercy, so it matters how good they are. They're down there and they tell you what they see or feel depending on how clear the water is. If they don't see it or feel it, you don't know it's there."

Hardesty & Hanover hasn't used underwater photography, although Christie has seen demonstrations of the technique. "You have pictures of what you have pictures of," he says, "but you don't know what's next to the picture."

Materials are another area to consider. "On weathering steel bridges, you can't see the cracks because you can't see the rust lines," Christie says. "That's a concern. On a painted bridge, you can see the rust line."

Better paint systems are one bright spot in bridge maintenance, Christie believes. "Synthetic-type paints — the urethanes, the vinyls, and the zinc-rich primers — these new systems are the best of the material changes."

New design systems will need careful attention during future inspections. "Today, there's more leaning toward load-factor design," Christie says. "There was a similar history to this when the riveted era ended and the welded era began. Allowable stresses all went up and we were going to save weight and cost by welding.

"Then, the welds started to crack, and we had to penalize so many parts that we're now back to structures that may be as heavy or even heavier than riveted structures were.

"Somebody gets a new idea to save material by some new theory, but then they have problems with certain parts. Load-factor design may give more uniform live load capacity, but it may not. The proof will be in the pudding 20 years down the line, when these load-factor design bridges either are succeeding or have problems." ☐

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Mr. ROBERTS. One comment is that the eye is the best inspection tool, and I think this has been brought out several times today. It is really pretty difficult to be having a professional engineer, who has design and construction experience out, as an inspector.

I am here to speak as a representative of AASHTO, 52 organizations, but I know it is hard not to talk about my own state. I have in the area of divers, interestingly some of the younger engineers nowadays are scuba divers and you can get them licensed at a very minimal cost, so we have four licensed, professionally licensed and diver licensed engineers that conduct our underwater inspections so you have the best of both worlds there. Certainly that is possible in other areas of the country.

I think rather than new technology it is the application of existing technology, some of the techniques you mentioned come from the aerospace and defense industry.

Strain gages can be used much more than they have been, especially now that we have identified structures that have reached their age, steel bridges that have reached the point where we know fatigue is imminent. That can be determined from the number of loads that the bridge has experienced because the design criteria is based on a certain number of millions of repetitions of loads. And generally in the 25 to 30 year age range, a steel bridge will begin experiencing fatigue problems.

The use of strain gages has been employed in several of the states. I commented earlier that the states that have a good sophisticated maintenance program are probably using a lot of these techniques and learning from the experience of not only failures but maintenance problems around the country, and I think that is one of the items.

Strain gages, penetrant dies, ultrasonic transducers that have been used in the defense industry are being introduced by some consulting firms now. In fact, there is one application in Phoenix on an interstate project.

The results are yet to be proven, but they certainly can indicate a change in the dynamic responses of an individual member, and they argue that this would show that a crack has probably developed and then you would go in with a visual inspection.

Underwater photography has certainly improved today and as I read into the record earlier, the AASHTO bridge committee's guidelines to the states in the maintenance inspection manual, underwater inspection does not necessarily have to mean a physical inspection. It could include underwater photography and certainly the technology is there.

I mentioned trained engineer divers. To me that is a key. Cathodic protection has been available for some years for deck, to prevent corrosion of decks from the salts that a lot of us, even in our state, in our elevations, we have that problem and decks last about 10 years.

So we have done a lot of research in that area. Cathodic protection can be used on piers, and we are using it on a major structure in the saltwater environment of the San Francisco Bay area. It is an expensive initial investment, but probably well worth it in the long run.

Mr. **Oberstar**. Have you been able to transfer the technology in cathodic protection from pipelines to bridges, bridge piers and decks?

Mr. **Roberts**. That is basically what is done in the bridge pier area. In the deck area there are several experimental projects, not only in our State but nationwide, and it is really a transfer of that technology to help prevent corrosion and only time will tell.

Mr. **Oberstar**. Has there been experience—I guess you partially answered that, only time will tell—a long enough experience factor to show that cathodic protection applied to bridges can be effective in reducing corrosion?

Mr. **Roberts**. We think there is enough experience at this time. The indications are that it is certainly an improvement and it will extend the life of the steel. And we have applied it in several locations in the areas where we use salt to reduce ice on the roadway.

Another area that a considerable amount of research has been completed and the Federal Highway Administration has produced some reports is the use of coated, epoxy coated reinforcing steel. We use it in decks throughout the country now and also substructure members that would be subjected to corrosive environment.

There is some research that the AASHTO committee is interested in helping—the Corps of Engineers as you may know, has conducted saltwater environment research up in Maine for bridge members and they are going to set up a site down in the Gulf now to look at the response and the experience of members in saltwater in a warmer environment. But continuation of that type of research to improve the design details is critical.

I can't repeat enough, and I did earlier in my testimony, that learning from bad experiences regardless of who had the experiences, we should all pick up on that and improve design details.

You know, the bottom line, if you can design a structure to minimize problems, deck joints, bearings, the kinds of details that create problems, then you are not going to have a maintenance problem to begin with. So it really goes back to learning from experiences and improving on the design.

Those are some of the areas I see in the expansion of existing technology and some things that are down the road that may not yet be proven but have some potential.

Mr. **Oberstar**. How responsive are other states or states generally to new technology or existing available technology, and how readily do they apply such technology in their bridge inspection programs?

Mr. **Roberts**. I think I have to repeat again, it really depends on the state. Earlier in my testimony, I mentioned that, and the subject was brought out again, with the last speaker, that is the issue of maintenance.

The federal program does not address maintenance, it is a state management therefore. In our state, for example, the highway program, an annual budget of $250,500,000,000, is devoted to maintenance of the system. And approximately one-third of our budget goes to structures. So, there is a decision on the part of an owning agency there to provide adequate maintenance. If a State has a financial problem, they will tend to, as I mentioned in the written testimony, they will tend to rely on the Federal program for rehabilitation and maintenance. Excuse me, rehabilitation and replacement. That is the issue.

To me, that is the basic problem facing us here. There is no return of Federal money in today's program, to support maintenance. Certainly, as we build more, we have to pay more attention to the maintenance. So, I am not trying to skirt the issue, but I believe states who have a good maintenance program are picking up on all the latest technology, and those that don't, won't.

Mr. OBERSTAR. Thank you. I appreciate that. The gentleman from Pennsylvania, Mr. Clinger.

Mr. CLINGER. Following up, in essence what you are saying is that we would in effect save limited resources if we were willing to devote more resources to maintenance and not have to wait to the point where things deteriorated to such an extent that major rehabilitation is required.

Mr. ROBERTS. That is basic, sir, with your home, your car, or whatever. You have heard other States here testify that if you don't maintain, you are going to have to replace it at a much higher cost because of inflation and et cetera.

Mr. CLINGER. How do we go about convincing other States who haven't had the kind of disastrous event occur that some of you have experienced of the merit of that argument?

Mr. ROBERTS. As long as you have a replacement program, in lieu of maintenance, it seems to me that you won't convince some people.

Mr. CLINGER. So it really takes some direction from the federal level to change that emphasis?

Mr. ROBERTS. I don't see how it can be done otherwise given the history at this point.

Mr. CLINGER. Mr. Burns, I was interested in your taking exception to the NTSB's finding of probable cause of the Mianus collapse.

You stated that your investigation has indicated that the cause of that collapse could not have been identified by a inspection program, that it was a design failure.

I am wondering, how do we address that problem, if in fact a number of these disasters that have occurred have been design related rather than due to any problems with an inspection program. Do we need to put greater emphasis on scrutiny of bridge design?

Mr. BURNS. Yes, sir. I think that is just exactly what we need to do. You need the involvement of your bridge safety engineers in the design process.

Mr. CLINGER. They are not presently involved?

Mr. BURNS. They are in the State of Connecticut, now. They did not used to be.

Mr. CLINGER. Not necessarily nation-wide?

Mr. BURNS. No, I don't know of any requirement that they be involved. So, I would imagine that it is spotty, depending on the experience of the State. I don't know.

Mr. CLINGER. Let me focus on this for a moment. Would it have been possible to have identified the Mianus design failure at the time the design was being formulated or was it only a result of later events that you realized the weakness of the design?

Mr. Burns. Well, if I only knew then what I know now, according to the expert we hired, a metallurgical laboratory at Lehigh Laboratory, Dr. Fisher and others we contracted with, to determine the cause, they are of the opinion, that is exactly where it should have been caught before constructed. This was not the only pin and hanger suspended span on the Connecticut turnpike which was built in a period time frame of about two and one-half years, entire 150 mile length. Of the quite a few of these pins and hangers, there is the only one to have this particular size, both length and gauge, which was determined also by the severe skew angle of the suspended span itself, which exacerbated the under strength and under length. It was also the only unfastened secured cap on a pin and hanger assembly that had no cotten pin or welds or anything else on it.

Mr. Clinger. So, what you are saying is that if bridge safety people are involved in the design phase of bridge construction, some of the threat could be eliminated?

Mr. Burns. We happen to believe and Dr. Zetlin does, there was a gross error in design when done in the previous process. As a matter of fact, the size and gauge of the pin was reduced in size during the design process for some unknown reason.

Mr. Clinger. One of you testified to the fact that steel fatigue is identifiable and that you can actually determine what risks are associated with age. One of the things that I think concern any of us who live in the Northeast, is that we have a potential serious problem because of so many of the bridges that we are dealing with were constructed in the 1950s and 1960s, and a lot of them were constructed with steel. As we have heard today there just aren't enough resources at this point to do the kind of rehabilitation work that you gentlemen are suggesting probably needs to be done and a large number of bridges, particularly in the Northeast and western parts of the country. Could some of those things you mention, Mr. Roberts, be applied to lengthen the safe life of these bridges that were constructed in the '50s and 60's without having to have a total replacement of those bridges.

Mr. Roberts. Yes, sir, we employed a consultant to determine the remaining life of a major structure that we intended to widen. It is in a salt water environment, although it is not a major salt water area, of the state. The bridge has been in use 25 years, so it is at that point where it should be looked at. There are several consultants in this country who responded to an RFP. So there are experts, Dr. Fisher from Lehigh University, on the East Coast is an expert in this area, has spent his life researching fatigue of steel and has some excellent ideas on upgrading connections.

Normally, connection details are where your problem initiated. And, we will in the widening of this structure rehabilitate the truss members if it is found to be necessary. A lot of it depends on the stress ranges that the elements have been subjected to. This is the reason strain gauges are a good tool because you can measure the time history. We measure it in a one-week period of time to measure the stress ranges compared to what the original design assumptions were.

That kind of technology is available at a reasonable price, compared to cost of replacing. Members can be upgraded. In California, we have done a considerable amount of reinforcing steel members with prestressed rods to increase the load carrying capacity and that is another issue that all of us face nationwide, increase the load. You can increase the carrying capacity of the existing structures quite easily.

Again, that is maintenance money. That decision by the state generally or owning agency and I think members of this panel are the kind of people who are willing to make that commitment. Other people have a very serious economic problem in the amount of local money they can raise, frankly, and they depend very heavily on the federal return of the federal share of their tax.

Mr. **Mladinov**. Picking up on the point about types of steel and fractures and brittle steel, there are certain types of steel that are allowed under the AASHTO standards and Federal Highway Administration standards, that are more prone to brittle fracture and cracked propagation and particularly when the temperature is extreme.

We have a major bridge in the Albany area that is only about 15 years old, at this point that on inspection we found that one of the steel pipes had cracked all the way through from the lower flange all the way to the top flange. The crack was initiated at a weld, at a particular type of connector, which we have discontinued. We had previously taken it out of our standard bridge designs, because our structures expert and welding experts have felt that it might very well be a type of design that might lead to a crack and cracked propagation.

As a result of that one beam that cracked all the way through, we furnished reports to AASHTO and Federal Highway Administration on that. We are undertaking a very detailed inspection of every welded bridge that has that type of provision in ithe, and in the particular bridge that did have the beam, there is over 20 miles of beams in that one very, very complicated interchange that requires inspection; that we are doing that type of inspection; looking at every weld in those bridges that have that type of steel and that type of connector to determine whether there must be a crack or a crack initiation in that weld detail that could lead to a complete break in the beam.

We are no longer using that type of steel, no longer using that type of weld detail, but there are a lot of bridges out there that do have that steel and detail, but there are a lot of bridges out there that do have that steel and detail and many states apparently are still using that type of steel and that type of detail.

Mr. **Clinger**. Thank you. I would defer to my colleague from Connecticut, because I understand Mr. Burns has to leave at 1:45.

Mr. **Oberstar**. Your testimony, Mr. Burns, has been very intriguing and there are a number of questions that I wanted to raise as well, but we will continue with Mrs. Johnson.

Mrs. **Johnson**. Thank you very much, Mr. Chairman. Commissioner Burns, it is a pleasure to have you here in Washington. I do regret that you have to leave because I am one of a panel that came up to Connecticut and held hearings after the collapse of the Mianus River bridge. We have followed this issue in great detail for many months and have long looked forward to hearing about Connecticut's work in this area. I think what you have done can be instructive for all of us and I appreciate the quality of your testimony today.

It is commendable that you have added people, equipment and training, improved the design process, and improved maintenance and follow-up and all those things. However, the fact that you had to do so reflects poorly on oversight by the federal program. I think that on the issue of followup, that is something we could even do through paperwork. Since most of our oversight has been through paper audits, I am very interested in the paper audit you have developed in the implementation of the recommendations of the inspectors.

I think that aspect of the Connecticut program is very relevant to our work. I am also interested that you are contracting out some of your more complex inspections and that, combined with some of the comments of Mr. Burnett, raises an important question in my mind.

Basically, what Mr. Burnett said was that there is no way the Federal Government can really know what the states are doing unless we come out and do a little of it themselves, both by appearing on site unexpectedly, during the course of an inspection, and in certain cases, conducting an inspection themselves and comparing their results with those of the state inspectors.

What plans do you have to exercise oversight over your contractors, because you are now in a position similar to FHWA with regard to your contractors. Indeed it was found when your program was investigated after the collapse that you were in the position in regard to your own inspectors. Indeed, you have the same problems in attempting to determine what is really happening out there on the front line.

How are you exercising greater oversight over them and what do you think of Mr. Burnett's suggestion that we should exercise greater oversight over you, by conducting occasional parallel investigations and by making unannounced site inspections.

Mr. BURNS. The oversight that we provide for the engineering firms that we hire is quite comparable to that which we do for contractors doing construction or any other contract for us. They are not out there by themselves. There is an inspector, engineering inspector and a representative of our bridge safety inspection, at all times with every engineering firm whenever they are doing work for us.

He has daily reports to make of their work activities, their hours, the section of bridges and he has to sign off on their submittals to us. The other comment I believe that you made was the follow-up process that we put in place, the best inspections are not worth a darn if the bridge maintenance or someone else does not carry out the recommendations in a timely manner, and I think we have put into place an effective method of communications between the various units of the Department and a followup required by the head of the bridge safety unit, to determine if in fact the work has been accomplished.

He has the authority to require work to be done immediately, without consultation with anyone, if he deems it necessary, and I think we have an effective method of controlling, or overseeing the contractors we hired to do bridge inspection work.

As far as the Federal Government is concerned, Federal highways, I suppose it could be construed to be a criticism of their oversight, and yet I didn't intend it that way. There was a process in place and there are requirements in place. Apparently, at least according to the record, the State of Connecticut historically had met those requirements.

The capabilities of any given FHWA Office in a given area are limited to their resources the same as ours are. It would take considerable additional manpower, competing in a tough market, to get the diverse kinds of talents necessary to do the oversight to the extent that Mr. Burnett appears to be talking about.

I think that an effective audit program oversight, physical oversight, could be put in place. It does have to be permanatized in each single jurisdiction. For example, regional units for the Federal Highway Administration, for example, as opposed to a State of Connecticut crew of bridge inspectors, or regional unit for Northeast, they could establish a pretty firm audit.

I am a firm believer. I know we are dealing with public safety. You don't spend $100 doing an audit to catch a nickel in a financial audit. So I don't think that we ought to go to overkill.

There needs to be physical oversight, not just paper oversight, because, paper is paper. It depends upon who writes on it.

Mrs. JOHNSON. Just briefly, so that perhaps the chairman will have a chance to ask you a question before you leave, you have stated that you oppose extending the inspection frequency period beyond two years. Eighty percent of the members of AASHTO support greater flexibility in the periods of inspection.

While you oppose that, you apparently support—at least that is what I gather from your testimony, you support a little more latitude for States in the depth of the inspection required, so that you would be able to require some less in-depth inspections?

Mr. BURNS. Yes, I would draw a line on that latitude also. It seems to me that there ought to be a formal process within which latitude is going to be given.

If there are going to be exceptions to what the norm is, those exceptions ought to be predetermined and approved and not just say, "Well, the State has latitude to determine the depth of an inspection." For example, I said before, that I would not even support a new bridge not being inspected within a two-year period of time.

As a matter of fact, all new bridges in the State, in Connecticut, we inspect before the first year is up, not just the acceptance inspection, simply because we don't know the creature yet and there are things that you learn about it as you go out there and get your hand on it and your crews learn about what it is, its idiosyncrasies. An identical twin bridge, or what appears to be a twin can be different than its twin in how it is reacted to, how it has been put in. Different people worked on it.

But after you have gotten to know it, when it is four or five years old, you have got a couple of these under your belt. Your guys don't need to go out there and do every single square inch of that bridge every time they go out there. They need to determine that there haven't been any changes from what they found the last time. That is what I mean by latitude, not freedom.

Mrs. JOHNSON. Thank you. I will yield to the chairman.

Mr. **Oberstar**. Go ahead.

Mrs. **Johnson**. Well, on this frequency versus the depth of inspection, I gather then that you are rejecting the testimony of others that, if we do the research, there could be categories set aside. I am thinking of some of the simpler bridges that could be categorically designated as needing less frequent inspections.

Mr. **Burns**. Well, if they do the research, I am not sure I know what research they are talking about. If I knew that, I knew the probability of the success of that research or the determination of it, then I could perhaps discuss it, but it is too iffy a question for me to support their contention now.

I would support them doing the research.

Mrs. **Johnson**. Mr. Chairman, the rest of my questions are fairly specific, and I request to have them answered for the record. I yield back, and thank our Commissioner for being here today.

[Questions from Mrs. Johnson and responses from Mr. Burns follow:]

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HOSPITALS AND HEALTH CARE

SELECT COMMITTEE ON
CHILDREN, YOUTH, AND FAMILIES

December 4, 1987

Honorable J. William Burns, Commissioner
Department of Transportation
24 Wolcott Hill Road
Wethersfield, Connecticut 06109

Dear Bill:

I just wanted to thank you for your excellent testimony before the Investigations and Oversight subcommittee earlier this week regarding the state's bridge inspection program.

It was a great pleasure to learn of the many actions you have taken to assure improved quality of bridge inspections and greater accountability of the system's many components. Your personal dedication, rigorous review of our state program, and leadership in making change are truly commendable and a credit to you personally and to government as an institution when led by people motivated by the highest ideal of public service.

There were a few items that I did not have time to discuss with you so I would appreciate your responses to the following questions. With your permission, I will provide them to the subcommittee for its official record of the hearing.

o Underwater inspections are an integral part of any bridge safety program. Why, then, does the Department contract out for these services? Isn't this kind of expertise needed in-house? What is the approximate cost differential between contracting out and maintaining in-house expertise?

o After the Mianus River Bridge collapse, much was made of the unavailability of a "bucket" truck necessary to perform over-the-side inspections of high bridges. Does the Department now have such trucks? If so, how often are they used? Are inspections that normally require such equipment permitted to proceed if a truck is unavailable? Have inspections been cancelled due to the unavailability of appropriate equipment? If so, please cite examples.

o Page three of your testimony referred to a reduction in inspection team workloads from 800 per year/per team to 600 per year/per team. Is this a realistic number? How many bridges can be professionally inspected by a single team each day? How reliant is the Department on overtime spending to meet these goals?

o Please describe in detail the Department's oversight of the outside contractors that perform all inspections on "complex" bridges. Are these bridges inspected on a defined schedule?

o Adding inspection instructions to design plans is an excellent idea and I commend you for ordering it. Are steps being taken to design fracture critical details and fatigue-prone areas out of bridge construction plans?

o Could the new bridge design plans that assure easy access for inspections inadvertently invite easier access for vandalism and/or sabotage?

o In addition to the procedures spelled out on page five of your testimony, what steps, if any, are being contemplated to force town governments to comply with bridge load posting requirements?

I appreciate your commitment to transportation safety, Bill, and look forward to hearing from you soon.

With best wishes,

Very truly yours,

Nancy

Nancy L. Johnson
Member of Congress

NLJ:rl

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
24 Wolcott Hill Road, P.O. Drawer A
Wethersfield, Connecticut 06109

Office of the
Commissioner

An Equal Opportunity Employer

December 22, 1987

DEC 24 1987

Hon. Nancy L. Johnson
Member of Congress
Sixth District
1 Grove Street
New Britain, Connecticut 06053

Dear Congresswoman Johnson:

Thank you for your kind words about the improvements made in Connecticut's bridge inspection program. Your visit to the Mianus River Bridge during the time when we were returning it to safe service was appreciated by the staff and the contractor forces.

Relative to the discussion points in your letter, the following responses are applicable:

I agree that underwater inspections are critical to the overall inspection of bridges in a water environment. The Department retains consultants for underwater inspection. This is not on an on-call basis. These special consultants are committed to a regular schedule of ConnDOT bridge inspections. Moreover, the Department has committed to in-depth stem to stern inspections of major structures in addition to our regular inspections. When these major structures are over water (and many are), the inspection includes an in-depth underwater evaluation as well. Does all this cost more than in-house underwater inspection capability? Yes it does, but I believe the retaining of specialized professional consultants used to operating in turbid waters with the latest in diagnostic tools is the more safety-reassuring way to go. We will keep exploring the in-house capability versus consultant ways of doing underwater inspection. Be assured that the consultant method employed by ConnDOT gives us full confidence that we are meeting and exceeding underwater inspection requirements.

On your question of availability of over the bridge side equipment to aid inspections, I am pleased to inform you that the Department owns two "snoopers" (as they are called), to aid inspectors. With this equipment, inspectors can maneuver to within inches of girders under a bridge to check for cracks and corrosion. We also own a MOOG over the side machine (truck mounted) that has a platform on it that can support many workmen and their repair equipment such as welding machines so we can go beyond problem detection to corrective action. With all this equipment and people trained to use it effectively, we don't have the problem of unavailable equipment to do inspections.

Relative to your question on how many bridges can be professionally inspected by a single team each day, the answer is dependent on the size, length, and complexity of the bridges coming up on inspection time cycle. Some bridges barely make the definition of bridge (span 20 feet long). Others are major river crossings. We do have our inspection teams on overtime (approximately 10 hours per week) and have senior engineers to give the inspectors first-hand structural information in the field to make the inspections both efficient and effective. Also, 650 "complex" bridges (major river crossings, viaducts and unusual and complicated designs) are assigned to consultant engineering firms who have professional engineers leading teams to do in-depth inspections.

To get into a related question you had on the two bridge engineering consultant firms retained to do in-depth inspections, these firms do a "hands on" examination of all exposed parts of the bridge. They also do nondestructive examinations (such as ultrasonic, magnetic particle and radiographic tests) as deemed necessary. The firms do these inspections on the bridges' normal two year inspections. The firms' product is overseen by professional engineers in the Department who then program remedial repair work to be done. Our inspection program is reviewed regularly by the Federal Highway Administration and it has been found totally responsive to the inspection needs.

We are making our new bridge designs as fail safe as possible. The knowledge gained on inspections is used in critiquing new designs and adding ConnDOT's voice to the American Association of State Highway and Transportation Officials (AASHTO) guides for nationwide criteria.

As your letter mentions our new designs incorporate more catwalks, access portals and hooks for safety belts They are designed to get inspectors and bridge maintainers up close to potential corrosion points and other areas needing lubrication, painting, etc. This access is not at ground level though. It still requires ladder climbs or having a padlock key to gain access. We endeavor to make the undersides of bridges as open (therefore visible) as possible for inspectibility purposes. That may keep them less prone to vandalism because there are fewer dark corners for people to hide.

On your last question of forcing towns to comply with bridge posting requirements, we use clear letters to municipalities of the need to post. If laxity follows, a second letter is sent stating that "In accordance with Federal law and regulation, if notification of posting is not received within thirty days, action may be initiated to deny further allocation of federal aid highway funds to your municipality." The adverse publicity generated by letters to the municipality that a bridge posting is being ignored prods the town officials to take action.

Your questions on our bridge inspection program are welcomed. Our watchword on bridge safety is "vigilance." Thoughtful inquiries such as yours permit us to inform you and your constituents of what we are doing and where we have made improvements.

Happy Holiday and New Year.

Very truly yours,

Bill Burns

J. William Burns
Commissioner

cc: Hon. William A. O'Neill

Mr. OBERSTAR. We are very fortunate today we have not had any of the usual interruptions for votes and quorum calls on the House Floor. This is a rare occurrence for a subcommittee to be able to go this long without a call of the House taking us away from the hearing.

I just want to ask one point about your opening remarks, [illegible] engineer hired by the State of Connecticut after the collapse [illegible] study that bridge, and his comments that it was inevitable [illegible] collapse would occur, given the bridge design.

Are there bridge designs that are dangerous, that should be avoided?

Mr. BURNS. This one certainly was, in our opinion. This bridge never should have been built as designed.

Mr. OBERSTAR. How did it slip through your review process in the State?

Mr. BURNS. Well, if I could have found one of the individuals alive who had reviewed it, maybe I could have found out. This bridge was designed in 1951, 1952, reviewed in 1952. It should not have, but it did. It was designed by a consulting engineer, but [illegible] was reviewed and accepted by the Department engineers, and [illegible] of them signed off on it, not one of whom was alive.

Mr. OBERSTAR. I asked the question not for pinpointing [illegible] but for learning from the experience so that other States can avoid making the same mistake.

Mr. BURNS. I really don't have an answer for that. The review process did not pick up a gross error in the design of the pin and hangar assembly in conjunction with this severe skew off the suspended span. And it was calculable at that time in the opinion of our Dr. Zetlin.

Mr. OBERSTAR. Your testimony reflects a very responsible attitude in dealing with inadequacies in its programs and responding to those inadequacies and improving your budget for inspection and operations. I would hope that the State has shared, through AASHTO and through the Federal Highway Administration and with other States, this particular design flaw and problem, so other States can avoid that same problem.

Mr. BURNS. We have made every bit of information available through AASHTO and we have made it available to jurisdictions [illegible] foreign countries who have asked for it. We have been visited [illegible] representatives of public works organizations and highways from Japan and Germany and France and several other countries, who visited us following the publication of the report, and had discussions with them about it, too.

Mr. OBERSTAR. One final point.

At the current rate of inspection, you are doing 600 bridges a year per team. That works out to three or so bridges per work day. They have to be working awfully fast to stay up at that pace.

Mr. BURNS. No, because the 3,600 bridges and 1,200 local bridges includes 8- or 10-foot box culverts or double round culverts and the like, they really don't take that long. There are work orders identified by geographic territory, so they can do a dozen of the smaller bridges in a day. Now they will be assigned the time. Particularly from May through Daylight Savings Time through November, there are assigned six days a week, and 12 hours a day, so that we take advantage of the daylight hours.

Mr. **Oberstar**. Thank you.

Does the gentleman from New York have questions?

Mr. **Molinari**. No questions.

Mr. **Oberstar**. Well, the witness is excused.

Mr. **Burns**. Thank you very much.

Mr. **Molinari**. Mr. Chairman, I would like to welcome the panel before us, particularly Mr. Mladinov, who has appeared before us before, and I am proud to hear his testimony from time to time. He comes from my home State, and is acknowledged to be one of the leaders in this field.

One of the problems that I have in reviewing the various bits of testimony is what the role of the Federal Government is in this area. And, more importantly, what should be the role of the Federal Government.

I look at the NTSB testimony, and without question it is somewhat critical of the new proposed rulemaking. AASHTO tells us that 20 percent of their members are opposed to the rule, but 80 percent support it. I guess I wouldn't be too impressed if you said 100 percent supported it, since it is not mandatory to begin with.

Number two, you could adopt more restrictive regulations if you felt that they were desirable, such as we are doing in New York State, but I think particularly in light of the fact that you are able to do that, it concerns me that 20 percent of the membership is saying they are opposed to this rulemaking change. What are they telling us? The message I am getting is that we are worried about ours and our other States if you provide flexibility and inspection becomes longer, we expect that that could lead to some problems. That is my interpretation, otherwise I don't know why a State would oppose the rulemaking.

Can States adopt a stricter standard? I guess I have to ask the gentleman from AASHTO, why it is that 20 percent of his membership is saying they don't want to see this rule change?

Mr. **Roberts**. I don't know that I can respond any better than my best guess. I think it is very similar to our own comments. Some States have a one-year interval, now they don't want to change that. My own State, for example, my maintenance engineer told me, that we, like New York, would opt not to change. We have a program in place, and it doesn't buy us anything to change and go to the higher frequency, although I think some States, and it has been stated by our staff at AASHTO that probably two-thirds of the States would not opt to make the change.

I think they feel they want the flexibility if we do have a problem with some bridges, we need to increase the intensity of inspection, without having to put on new staff or go out to increase resources, we could ask for and hope to get approval for an increased frequency on some of the types of structures we have discussed.

Mr. **Molinari**. Of course, we can talk about flexibility and that is something that probably should be discussed. What I am hearing, 20 percent of the States that belong to AASHTO have said no, we are against it and two-thirds, 75 percent are saying, we don't think it is a good idea but we won't object to it because we are in fact adopting stricter standards.

As a member of the Federal Government, that concerns me, because I think that what I am hearing now is a rather broad consensus that this proposed rulemaking is a mistake and that we may want to rethink the issue in terms of flexibility. We are getting some warning signals here from some of the States saying don't let it happen, it could lead to trouble.

I welcome anybody on the panel who might want to respond to that observation?

Mr. MLADINOV. I really can't speak for those that voted the way they did vote, but I can imagine that some might be concerned about a provision that has flexibility built into it, because the pressures might then be on the DOT officials to take advantage of that flexibility, even though it may be against their better judgment from a professional and engineering standpoint.

It is like we as a general fund State where highway user revenues are not dedicated to the highway program, we have to compete in the Legislature for appropriations every year, just as any other State agency does. We do not have the protection of dedicated highway user revenues.

Nonetheless, we have done very well in that competitive arena in getting significant appropriations on capital side, and have been able to increase our appropriations on the maintenance side. We know that in that arena, the pressure is on the States always to take advantage of whatever might reduce costs.

We are mandated in our State to inspect school buses no less frequently than once every six months. There was a budgetary proposal to increase that to nine months for a cost saving reason. We opposed it, and the Legislature did not approve it. But that was a type of budgetary pressure that is placed upon, at least in our case, a general funded DOT, in contrast to a dedicated highway user revenue.

Mr. MOLINARI. That is a very interesting point. In effect, what we are hearing is big brother is still called, and can in fact help people like yourself by imposing requirements, and that gives you the leverage that you need with your legislative bodies in order to secure the necessary funding to provide the safety everyone is looking for.

Mr. MLADINOV. Yes, sir, exactly.

Mr. OBERSTAR. Would you yield?

Mr. MOLINARI. Yes.

Mr. OBERSTAR. You raised a point that I am going to raise tomorrow with the Federal Highway Administration and I also wanted to explore with this panel. In 1984, the Federal Highway Administration withdrew a similar rulemaking proposal with this comment:

> * * * Federal Highway Administration has determined that the proposed inspection interval increase is not in the best interests of the public safety * * * Further, it is believed that safety benefits of the existing regulations far outweigh any potential economic benefits of an increased inspection frequency.

Having made that judgment, they withdrew the proposed rulemaking. Now, they are coming back with a much longer period of greater flexibility. Why? And why, when so many of the states are saying, please don't give us that flexibility, don't give us the longer interval, it is not in the best interest of safety.

Mr. MOLINARI. You wonder what has happened since 1984, to cause them to reverse their position and to say we were wrong in 1984 in our conclusion, therefore, we are going to resubmit that rulemaking.

Mr. OBERSTAR. Precisely.

Mrs. JOHNSON. It does strike me that the rule only allows states to apply for permission to increase inspection frequency and also requires a great deal of backup information to justify extending and adopting a less frequent schedule. So presumably, what the States could do is to take those culverts—very short bridges—that are common in Connecticut, I went with a bridge inspector after the Mianus bridge collapsed and we inspected several different kinds of bridges, including crawling through a culvert bridge, and that really isn't difficult. Such a bridge isn't likely to collapse, and if it does, it is going to collapse in a way that is not going to endanger human life. It might wreck your car, but it is not going to kill you.

It does seem to me, logical and reasonable, given the pressure on public resources, to inspect bridges based on research. It would have been ideal if we had conducted the research first and then said these are the types you can inspect less frequently. I certainly will be pressing FHWA to know where they are in conducting research. I would like to see them do it. But it seems to me that guys like my commissioner and clearly you as well, sir, who because of the circumstances in your state, have really hustled in the last couple of years, know a lot more about your bridges than we or many State commissioners, ever will. Your justification of why certain categories might be extended, could be extremely useful to us.

If you can't justify it, you are not going to get it, and we will find out that it isn't working. I hear what my colleagues are saying, what you are saying, about the 20 percent who oppose an increase in inspection intervals, but the rule does not provide that flexibility, and I think we have a choice about exercising much more control over those State proposals, rather than not allowing that effort to go forward.

Now, wouldn't you, as a member of AASHTO, be one of the people who wanted to be certain that the justifications were real and won't you have a chance to exercise some control.

Mr. MLADINOV. Our comment to the docket was not in opposition to the proposal. Our comment was that there may well be situations in other States and so on, where it would be appropriate to have a longer cycle between inspections or types of bridges. Our point was, basically—you would have to read our statement to the docket—by saying we would not object to having such a rule promulgated as a final rule.

We simply did not feel we would be comfortable taking advantage of it, but our traditional position has been to reduce the level of dictation and requirement at the Federal level to allow more options to the States. Certainly there is no entity of government that should be more concerned about the safety of bridges than the local level of government that is responsible for the bridges. We are going to be the ones that are held responsible for whatever occurs with those bridges. It isn't going to be the Federal Highway Administration or the NTSB, it is going to be us.

We should have the greatest concern about assuring as close to 100 percent safety for every facility that is out there. We are going to be held liable if it isn't. So giving us options, to me and relative to our comments to the docket, was support.

We prefer options. We are not in a position to say whether other States, in exercising those options, will do so imprudently. We would hope that they would have exactly the same concern that we have for the safety of the public, but we don't know. We know there are various levels of adequacies in inspection programs from State to State. We feel that we have one of the best ones, and the Federal Highway Administration said so. That did not prevent us from having a Schoharie Creek bridge failure and reports on that will show that—particularly I think the NSTB reports—will show that the inspection frequently was not what it should have been, nor was it a depth it should have been. That inspections were in accordance with the authorities manual, not in accordance with the State Department of Transportation manual, and that is what we want to change in State legislation.

Mr. OBERSTAR. Mr. Roberts.

Mr. ROBERTS. Yes sir. Mr. Burnett articulated very well the need for quality inspection. I think we are dwelling a little bit too much on the frequency. To me that is not the major issue. I think the States, member States, who have a good program would welcome an in depth review by the Federal Highway Administration and it certainly could be handled the same way we do when we write specifications for inspections during construction. You have a level that is determined. If there is no problem that level is maintained. If there is a problem, you increase the level. You put on the heat. So, that should certainly bring people into compliance that are not in compliance.

One thing that, as the Technical Subcommittee on Bridge Inspection is doing this year, is that item will be on our agenda at our meeting in the spring in Atlanta, we are looking into levels of inspection. You are going to hear later in this testimony from a consultant who is a bridge inspector, and does this as his primary occupation, and he has spoken to our committee last year, as well as another gentleman from the State of New York on the same subject. There is no identification of levels of inspection if these consultants contract with the State, to conduct inspections. They have been chastised in court on several occasions by a judge stating that they didn't do certain things, the consultants feel it wasn't in their contract, and the judge chastised them that they should have known better because they were consultants.

It is hard to negotiate a contract on that basis. So, what we are attempting to do, we have gone out to the member States on the committee and will have this item on the agenda. We are trying to identify some levels of inspection, so people can have a basis upon which to contract.

For example, most States have maintenance crews that patrol the roads, their job is to fix a break in the railing or a pothole in the deck that they see and that is immediate and they are out there daily. That is a level of inspection.

The regular levels we are talking about, whether it be six months, one year, two years, or five years, conducted by professionally qualified engineer inspectors, is another level, and is an important one. Most of those are documented with a written report.

I mentioned earlier in my testimony that on certain large structures in many States, there are resident inspectors, full time job. When you have a bridge several miles long, that is a full time job for an inspector to keep track of it.

This probably takes a couple of years to get States to agree. When they do, then this material will be incorporated in the inspection manual. I am certain the Federal Highway Administration will then adopt it.

Mr. OBERSTAR. Thank you.

Mr. MOLINARI. I guess what I am hearing now, Mr. Roberts, is that AASHTO doesn't agree with the proposed rulemaking and has a tendency to agree about the criticism of it by Mr. Burnett, that instead of focusing on inspection intervals, they ought to look at providing flexibility in the depth of inspection required. Is that what you are saying to us?

Mr. ROBERTS. We don't object to the flexibility. There is quite a few elements to the rulemaking change. There is detail that will be increased each year, as AASHTO member States adopt some of the items that I have read into my testimony.

I think that some of the criticism earlier is that the rulemaking doesn't go far enough, and that it is an evolutionary process. I believe in addition, rules AASHTO has adopted will be picked up by the Federal Highway Administration. This has been typical historically. We work together.

Mr. MOLINARI. You say don't go far enough. You mean in terms of flexibility or in detail?

Mr. ROBERTS. I think Mr. Burnett made the case that there wasn't enough oversight, nor was there enough detail in some inspections.

Mr. MOLINARI. I would like to get back to Mr. Mladinov's statement that in fact the various States are the ones that that have the primary obligation to ensure safety. Yet in your testimony you allude to the point that I witnessed firsthand as a member of the state legislature in New York that several public authorities in the state created a lot of power over the years over their roads and bridges. Yet, as you stated, there is no obligation on the part of those authorities to comply with state DOT inspection requirements.

Of course, because of the collapse of the Schoharie bridge, the rules of the game are changing somewhat and you expect some legislative relief which I guess would mandate that the public authorities in New York State be subjected to the mandatory inspection provision of your department. Is that how you envision it?

Mr. MLADINOV. Yes sir. We also have, as I mentioned, our own inspection manual, our own requirement for qualifications on our inspectors, that go beyond the Federal requirements relative to professional engineers status—being one. In addition to that, the forms that we use are far more detailed. They are so detailed that it requires the inspector, in order to be able to fill that form out, to visually inspect every element of that bridge. Otherwise, he is unable to place a rating on every element that is required to be rated by the inspection manual.

Mr. MOLINARI. Generally speaking, where would you say your requirements are stricter those of the public authorities?

Mr. MLADINOV. Stricter than Federal Higway Administration. The authorities typically have bonds outstanding and the bond covenants typically require them to have annual inspections of their facilities in order to have security for the bond holders. Now, those are not prescriptive and typically those covenants require an outside independent engineering firm to be the one that makes such inspections and determines their contents.

Now, there is a variation between consultant engineers for one authority as against another authority. Some are making annual inspections, some aren't making annual inspections, but every five years they have an extremely detailed, in depth inspection. There is a variation from one authority to another authority and what we would like to do is to establish at least a minimum criteria.

Some of those authorities do not have outstanding debt, so they do not have a consultant engineer that is required to inspect and report to the bond counsel and to the bond holders. We would like to bring them under an umbrella where there is a standard and where there is oversight.

In our program we also have initiated quality control. So they do not have the same inspection team making an inspection of the bridge twice in a row.

We rotate the crews.

We make spot rechecks of inspections of the crews. We bring in crews from the adjoining region to move into an area and spot check the inspections made by the crews. We also, with our consultant firms that are doing the local bridge inspection, we rotate them as well.

And we also make spotchecks of their inspections, but we don't allow the consultant to make inspections in a row on the same bridge.

We have another firm do it. Everyone that is doing inspections knows that he or she is liable to have someone come back and look at what they did and it keeps them on their toes.

That was done because of the learning process from the Mianus River Bridge experience as well as from our own experience.

We took the Inspection Program out of the maintenance organization. The AASHTO Manual for inspections is an AASHTO Manual for maintenance bridge inspections.

It was intended to be written as it was conceived, done by maintenance people.

We felt bound from our own experience that the maintenance people have their own crisis requirements. Many tasks in the summer or winter have to take priority.

Bridge inspection was just an added burden to them that they used as a fill in. They were not dedicated to the cause.

They were doing many other things in the course of the year. They did not consider themselves bridge maintenance experts, so we took it out of their Department and put it into the structures division that only had the design function.

That created having the safety people in the same or being able to input into the design function so that the designs can indeed reflect the learning experience from the inspections and also make inspections easier.

So there are a number of things that we have done and did prior to bridge failures and I would hope that others are doing the same thing.

It was not done under the pressure of Federal requirements or Federal mandates. We have gone voluntarily beyond that and will continue to do that.

Mr. MOLINARI. Everybody is in a state of panic in the City of New York on the fate of the Williamsburg Bridge. Can you give us an update on that?

New York City is very dependent upon its bridges and the Williamsburg Bridge is temporarily closed while a decision is made to take it down or whatever.

With the number of vehicles that we have crossing the rivers, it is of great concern.

Mr. MLADINOV. The four East River Bridges in New York, including Williamsburg and the Brooklyn Bridge, Williamsburg was built in the 1900's, built under practically a dare that a bridge could be designed and built for less money and in a shorter time frame than with the Brooklyn Bridge and the designer was able to achieve that, but he ended up with a design that is a difficult design.

It is not a true suspension bridge and has had to be redesigned in order to provide additional support to it.

As one of the measures to reduce the cost the suspension cables were not made of galvanized iron or steel, so they are ungalvanized and there was impregnation of the cables by materials assumed to keep moisture out.

Those materials didn't work, different materials were used, some of those materials actually seem to have generated corrosion as well.

But those bridges are not State bridges to begin with, they are city bridges, but the city had asked us to come in because they felt that the problem was greater than they could handle.

I mentioned budgetary pressures, we have a lot of criticism from the budget types that are saying you have no business getting involved in those, that is a city problem and the State shouldn't be involved.

We felt we had no choice under the circumstances, but opening up segments of the cables, spreading the wires apart, showed that there was indeed corrosion to the distance that those cables could be viewed.

We were not able to get into the core of the cables in the earlier studies. There was also a computer model of the rate of corrosion and what they would indicate would be the ability of the bridge to stay in service.

Those models showed that by 1992, the bridge safety factor would be such that we would either have to close the bridge or load limit it.

The more recent studies, which have looked at much more of the cables and in depth getting into the core of the cables are showing that the corrosion is far less than the initial samples.

We are looking at more cables as well as more places and there are not as many cable breaks. At the anchorage, strands of the cables are broken, some of the metal has become quite brittle.

The safety factor is still well up there, it is over two, but the new models are going to show that that bridge has much longer life span with the existing cables than had been predicted before.

However, we have simultaneously going on an effort looking at replacement options and it will be an international competition for concepts for replacement options.

The Federal Highway Administration had felt that it did not make much sense to spend hundreds of millions of dollars to replace the cables and still have an old bridge there with a more limited life.

It would make more sense to spend more, more than they are offering to us in Federal funds, spend somewhat more and have a new bridge with a longer life and have full standards.

The new studies should give the public much more confidence that they are traveling in safety and they have a bridge there that has a much longer life than was earlier indicated.

Mr. **Molinari**. I am grateful for such a comprehensive reply. I thank the chairman.

Mr. **Oberstar**. As always, the gentleman's questions are to the point and on target with the subject of the subcommittee's inquiry.

I was greatly interested in the statement from the Connecticut DOT representative who discussed diver qualifications.

Have other States adopted similar requirements for divers who inspect—who do underwater bridge inspection, and if not, is it feasible to extend those standards to other States?

Mr. **Mladinov**. We do not require our divers to be professional engineers. Some of them are professional engineers. We do require video equipment and the video is monitored by a professional engineer if the diver is not a professional engineer. And the inspection is video taped.

Now that is adding considerably to the cost of the diver inspection, but it gives us a permanent record and it also gives us simultaneous professional engineer inspection whether in the water or on deck reviewing the video screen.

Mr. **Oberstar**. Mr. Roberts, do you know what the practices are of other States?

Mr. **Roberts**. I don't know the practices of too many States, although the AASHTO guidelines that will be published in 1987—it is clearly stated that the inspection could be by underwater photography or a diver. In our case, we just happen to be lucky that we had some professional engineers that were interested in scuba diving and incidentally a scuba diver can go down to 80 feet. The cost in training and licensing is in the $1,000 to $2,000 range so it is a nominal cost.

I pointed that out as a possibility that could be applied in other States.

Mr. **Oberstar**. Do you think the inspection standard, and I noted with interest your comment about engineers also being interested in scuba diving, do you think the standards should be tightened with respect to divers who are not engineers, that they should have more extensive training and much more solid qualifications before being permitted to undertake such inspections?

Mr. ROBERTS. I don't think we should require the diver to be a licensed engineer, but I think we should have a licensed engineer on the site similar to what New York does. I don't know that it is reasonable to require States to license engineers as divers also. We happen to be fortunate out there. I am sure other States could do that.

The key is to have a qualified person looking at the video or directing the diver, telling him what to look for.

Mr. OBERSTAR. Does the proposed rulemaking provide such guidance and direction?

Mr. ROBERTS. Not at this time, but, sir, I believe while you were out I read into the record some additional guidelines that the AASHTO technical committee on bridge inspection has introduced that will become an interim this next spring and it addresses a little more guidance in the area of underwater inspection.

I know, frankly, that in our meetings on this item, when it was voted there was a lot of resistance. It took us a couple of years to get that item into our guidelines. There is a resistance by some States for whatever reason to incorporate—they want to probe with poles and things like that and in some instances, it is probably appropriate but you have to look at each site to make the appropriate inspection for that site.

Mr. OBERSTAR. Thank you.

In your testimony you refer to the five-year frequency for underwater inspection. In arriving at that five-year figure, were there studies or are there supporting data available to support that, to justify that five-year frequency as a reasonable period of time?

Mr. ROBERTS. I am not aware of a study or data, but I did read into the record again a section that is in the 1987 interim guidelines for bridge inspection which states that when it is subjected to a corrosive environment, structural steel substructure elements should be inspected below the water line and in the splash zone by manned or unmanned water surveillance at intervals not to exceed two years. We have brought to the forefront the problem of brackish or salt water and our recommendations are two-year frequencies in that instance, which means the five-year interval would only be used in fresh water.

We have also noted in here that coastal streams may be brackish due to tidal effects several miles back from the coastline and therefore should be considered a potentially corrosive environment. In our new guidelines, we have tried to provide more guidance in the area of brackish and this is primarily the result of the Chickasawbogue—the State of Alabama commented that the change in pH salinity in the water was more than the environment. The change in the content caused corrosion.

Mr. OBERSTAR. That would sound reasonable. It is also a factor that could be turned up with more frequent inspection. If there are changes in environmental conditions, you are certainly going to pick those up in a two-year period sooner than you will in a five-year period.

Has AASHTO interposed a comment or——

Mr. Roberts. We have put in the guideline now in our recommendation that it be two years in brackish or salt water, five in other instances. I think a good comment was made earlier by the State of New York representative that if you are going to inspect a bridge every two years, that is when you will do your underwater inspection also, so it is questionable whether many people would use the five-year frequency.

I would submit a clear-water stream, you could provide adequate inspection on a five-year frequency. It certainly might get you out of cycle with your normal inspection, and if you are going to inspect the bridge every two, you will do the underwater inspection also.

Mr. Oberstar. I would feel more comfortable if a two-year period were made the rule and allow States to submit justification for exemption for a longer period of time and make longer periods the exception rather than a longer period of time, the rule.

Mr. Roberts. That is the way the rule reads, that it is two years, and it says, however a State may submit, similar to the rule change that is being proposed currently, the maximum inspection may be increased or the depth of inspection may vary for certain types of bridges where the action is justified by past inspection reports and favorable experience and analysis. So that is currently in the AASHTO guideline.

So it is a two-year rule with an exception up to five. Underwater is two years, period, our recommendation.

Mr. Oberstar. Good. I think that should be——

Mr. Roberts. Excuse me, salt water, underwater inspection in salt water is two years. The normal rule for clear water is two with an exception process to allow frequency up to five years. Those are our recommendations in the AASHTO guidelines.

Mr. Oberstar. We heard testimony from Connecticut that their bridge inspection program involves teams conducting inspection of 600 bridges a year. Does New York State have a similar standard, and do other states operate on that same basis of a number of bridges per team per year?

Mr. Mladinov. We noticed the numbers in the Connecticut testimony and it does indicate that the Connecticut workload in terms of number of bridge inspections per inspection team is higher than in New York, and I think the factor was about two to one. There are many things that could result in that.

Mr. Burns pointed out some of the more complex structures are being done by consulting firms, much larger bridges, so that would cause them to, with their own crews, do more of the smaller bridges than in the State of New York where our people do the large and complex as well as the small.

Mr. Oberstar. It was said that many of their bridges are box-type structures and require less inspection.

Mr. Mladinov. In the written testimony, our numbers are there and you can draw that comparison. We showed the number of culverts and other types of structures that don't lend themselves to a particular type of analysis so you will get some sense of proportion compared to Connecticut's situation.

They may have more culverts in proportion to the total number of bridges than in New York.

Mr. ROBERTS. I believe from a national perspective, the New York statistics are more representative of the States in general. Mr. Burns did state that the size of Connecticut was a major factor.

You will notice in New York's testimony, it takes several days to get to some of the sites, set up the traffic control and the inspection equipment. That would be true in a lot of the western States such as mine. That level of inspection in Connecticut is certainly not indicative of the level of most other States.

Mr. OBERSTAR. Thank you.

There are a number of other points that I think should be raised. I want to condense the questions. But one I can't avoid is that of truck axle loads.

AASHTO referred to it in their testimony. I am sure every highway commissioner in the country is concerned about what AASHTO described as not only increasing weights but increasing numbers of trucks in this era of deregulation. In the Federal Highway Act of 1987 that was passed earlier this year, there is required a study of the bridge formula.

Now, the concern about 25- to 30-year-old bridges, fatigue setting in at that point, heavier trucks, more trucks—what concerns do you have about the bridge formula and the axle ratings and what things might you want to see come out of this study?

Mr. ROBERTS. Well, this has been discussed in bridge circles, and personally—I guess not personally, I am speaking for bridge engineers in general, I think the highway people are missing a point. Bridge decks are generally designed to carry the loads and increasing loads can be accommodated much more easily on bridge decks than they can on the pavement, and I think that is going to show up.

In our State, we have just completed an extensive concrete rehabilitation program and that is going to occur in a lot of other states. Historically, truck weights have increased. We have a lot of trucks on the system designed for the H-15 loading in the 1930s and because of redundancy, designs weren't as sophisticated in those years and we are lucky to have that built-in reserve strength.

As a result of this program to load rate bridges, we have found that a lot of bridges have more reserve strength than the original design of something. So to answer your question, we need the study because the truck weights, I believe, are going to continue to increase if history is a teacher and we have to be prepared for it.

Load factor designs, an attempt to help build in reserve strength, because you apply different load factors, which is a safety factor too, the life load of the trucks than you do to the dead load of the structure itself. That can be increased if there is going to be an increase in truck load. We have been lucky so far because of redundancy, because of designs.

Mr. OBERSTAR. Redundancy is important. The more redundancy built into the system, the greater the margin of safety and the better the prospects of assuring a safe structure.

One final question. Going back to the point raised in the Connecticut testimony that after the Mianus bridge collapse, the engineer's report stating that it was inevitable that a collapse would occur, do you feel comfortable that the current design standards for bridges rule out the possibility of an unacceptable design, an unsafe design being adopted for bridges in this country?

Mr. **Roberts**. I don't think you could ever be comfortable that a set of rules would guarantee, you know, a zero defects or zero problems.

Mr. **Oberstar**. Are the design standards such today, that if followed, they would rule out unsafe designs?

Mr. **Roberts**. I think that if followed to the letter, they will probably rule out unsafe designs. We get calls, any one of us that is a technical committee chairman gets calls weekly from across the country on interpretation. They are like any other set of rules: some of them are extremely complex. You wonder about all the people that aren't calling and asking for AASHTO's interpretation.

Mr. **Oberstar**. So it is in application of the rules that we have to be concerned whether the design standards are being followed?

Mr. **Roberts**. Yes, sir.

Mr. **Mladinov**. If I could add to that, the ability today with computer analysis to optimize the bridge design gives us that reduced redundancy and reduced safety factor that was referred to in the old 1930's H-15 design where there wasn't that ability to optimize. So the much more sophisticated capability to design a bridge today tends to reduce the over-design that was inherent in the previous designs of bridges.

Mr. **Oberstar**. Thank you very much.

Mr. Clinger, any further questions?

Mr. **Clinger**. Just one line of inquiry, Mr. Chairman.

Mr. Mladinov, you indicated that while you would not have objections to the possibility of changing the rule to allow some States to increase inspection intervals for certain types of bridges, such action would not be appropriate in New York State. I gather that would be because of weather conditions, the fact that so many of your bridges are aging and a variety of factors present in your State that might not be present elsewhere. You also talked about the manual which you have developed in New York State and I gather that that manual is specific to the unique characteristics that you have in New York State with regard to your bridges. Is that correct, or would your manual be the type of manual that could be universally applied?

Mr. **Mladinov**. I think it could be universally applied, yes.

Mr. **Clinger**. And it is much more comprehensive than and of the Federal manuals?

Mr. **Mladinov**. Yes.

Mr. **Clinger**. Is there any requirement that your manual be approved by Federal authorities?

Mr. **Mladinov**. No, there is no such requirement. The Federal regulation, as a matter of fact, requires the States to follow the AASHTO manual and the Federal manual. We did not get explicit approval to use this manual, however, because it did go beyond the Federal manual and the AASHTO manual.

Mr. **Clinger**. I am thinking that that might be a possibility. There might be a way to give states that could make the case for a longer interval between inspections, to do so, if there was a requirement that the State developed manual would clearly specify what the conditions were in that State that would allow for longer intervals and what conditions would not allow it.

For example, Mr. Roberts, in Southern California, you probably don't have a big problem with salt deposits on highways, or on the bridges, which tend to deteriorate them more rapidly like in New York State, Pennsylvania and the rest of the northeast where you will find salt on bridges.

It seems to me this might be one way to insure the kind of flexibility without a diminution in the safety aspects. The State could be required to make that case in a manual which would have to be approved by FHWA.

Mr. **Mladinov**. It would have to go beyond the manual. The manual basically is a manual on how to inspect and what to inspect, and what qualifies for a particular rating. So there is every element of the bridge is rated and pictures are shown of typical conditions and what appropriate rating should apply to that particular pictured condition.

For the option of changing the frequency, the manual does not address that. The manual is built within the concept of no less than every two years.

Mr. **Clinger**. It strictly applies to the procedures that you follow in conducting inspections?

Mr. **Mladinov**. Yes, sir.

Mr. **Clinger**. In each category of bridge?

Mr. **Mladinov**. Yes.

Mr. **Clinger**. Does it address things such as, or would it require a greater frequency, in an area that had a unique factor, such as increased load, increased adverse weather conditions, et cetera?

Mr. **Mladinov**. I don't recall there is anything in the manual per se, but there is a provision for the inspector to make an entry whether a followup inspection should be required, if conditions are such that another followup inspection is required, or more frequent inspection is required. We have separate provisions for determining and specifying the frequency over and beyond that inspector's entry, however.

Mr. **Clinger**. I see.

Mr. **Roberts**. I brought a couple of pages from the AASHTO maintenance inspection manual, which is adopted by states that either don't have the resources or time to produce their own manual and it is very comprehensive, I believe, in pointing out some of the factors you mentioned.

For example, it says, "For existing bridges the inspection unit should seek advice from experienced designers to determine if there is a need for greater than a routine inspection or regimen for any given period." And it goes on, that kind of detail. These comments that I have made earlier in my testimony in referring to interims, will be incorporated into the new manual. The manual is being rewritten at this time by a consultant for AASHTO, for our subcommittee. This is a laborious task, as you know. We finally hired a consultant to do it, because AASHTO is a volunteer organization. It will be out within a year or so.

Mr. **Clinger**. Thank you.

Mr. **Oberstar**. Mrs. Johnson.

Mrs. JOHNSON. I did want to know if any of the States or AASHTO is funding research to improve safety features in bridge design? Is there anyone pushing forward on bridge designs that will have fewer safety problems and reduce our reliance on inspections and inspection programs to assure public safety?

Mr. ROBERTS. I think that is our basic mission as the AASHTO organization, to develop design criteria, construction criteria, maintenance criteria. There are several research projects normally funded by TRB and the states through the committee suggesting necessary research. So we usually have a half dozen research projects ongoing at any time.

And at our annual meetings, we get updated and final reports on their status, but most any change, that is, major changes that are made here are backed up by research. So the answer is yes, there is a considerable amount of research, and the ultimate goal of any design code is to build a safe bridge.

Mrs. JOHNSON. Are some of the designs being formally dropped? Do you take a position on certain designs that seem to have had problems? Certainly the feeling of Commissioner Burns is very strong about the faults in the design of the Mianus River bridge. I wonder whether anybody at the national level is taking a stand to discourage the use of designs that have problems?

Mr. ROBERTS. People are looking at that detail. I think it should be pointed out that the statement was undoubtedly true, however, that can be fixed very easily. Because of the skew, it as easy for the hangar to slip off the pin. That can be fixed. And we are looking at that. There is a nut that holds the bar on the pin so it won't slip off, and I think in the old design criteria, that nut as more of a dust cover than a structural element. People didn't think about the pins, that the bar sliding off the pin. Now we are looking at that. It is very easy to put a larger nut and larger bolt to hold that nut onto the pin. That will keep the hanger from slipping off. That is being looked at.

As was testified earlier, there is quite a bit of information on this particular bridge failure which has been disseminated. The AASHTO Committee at two of its annual meetings, had Dr. Fisher there, and certainly others, to give reports, so we are very familiar. All of the state engineers are very familiar with that problem, and I think we would all be remiss if we didn't look at our own bridges, and especially in a sharp skew like that.

Mrs. JOHNSON. Thank you very much.

Thank you very much for your very good testimony, all of you today.

Mr. OBERSTAR. One final question. If the proposed flexible schedule, as proposed by Federal Highway Administration, is adopted in place of the two-year current frequency standard, what problems might arise for oversight by the Federal Highway Administration and its ability to report nationally and to Congress on the status of the bridge inspection program.

Mr. ROBERTS. I testified in my written testimony and summarized here earlier, that given the computer capability today, I don't see that the frequency of inspection is going to change the report that the Federal Highway Administration maintains and we submit to them, the States individually. We feel that they need another column in the NBIS data base which will note the frequency of inspections. On a day we submit data to Federal Highway Administration, that is the status of that bridge on the day we submit the data regardless of when it was inspected and what the frequency was.

Mr. OBERSTAR. Thank you.

Mr. MLADINOV. What he is saying is every bridge should be identified with a particular frequency, and that would show up in that extra data field. So, Federal Highway Administration would be able to very readily check whether the status is in compliance on the specified frequency for each of the bridges. That is how we are measured.

Mr. OBERSTAR. Thank you very much for your testimony. We greatly appreciate the time and trouble you have taken to be here, and to share with us your thoughts and your experiences in this very, very critically important area.

Mr. ROBERTS. Thank you.

[The prepared statements of Messrs. Roberts, Mladinov, and Burns follow:]

AMERICAN ASSOCIATION OF STATE HIGHWAY
AND TRANSPORTATION OFFICIALS

JOHN R. TABB, President
Director
Mississippi State
Highway Department

FRANCIS B. FRANCOIS
Executive Director

STATEMENT FOR THE

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
OF THE
HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

Relating to

BRIDGE INSPECTION AND BRIDGE SAFETY

by

JAMES ROBERTS
Chief, Division of Structures
California Department of Transportation

and

Chairman, Technical Committee on Bridge Replacement Surveys
and Inspection Standards
AASHTO Highway Subcommittee on Bridges & Structures

Washington, D.C.

December 1, 1987

Founded in 1914, AASHTO represents the departments concerned with transportation and highways in the fifty states, the District of Columbia and Puerto Rico, to foster the development, operation and maintenance of an integrated national transportation system. The active members of AASHTO are the duly constituted heads and other chief directing officials of the member transportation and highway agencies.

EXECUTIVE OFFICE: 444 N. Capitol Street, N.W., Suite 225 Washington D.C. 20001 Telephone (202) 624-5800

Mr. Chairman, my name is James Roberts and I am the Chief of the Division of Structures for the California Department of Transportation. I am also a member of the AASHTO Highway Subcommittee on Bridges and Structures, and Chairman of the Subcommittee's Technical Committee on Bridge Replacement Surveys and Inspection Standards.

With me today is David J. Hensing, Deputy Executive Director of AASHTO.

Mr. Chairman, I am pleased to appear here at your request and to provide testimony on the matters contained in the letter of November 10 signed by yourself and Congressman Clinger, inviting AASHTO to testify. Beyond these prepared remarks, I will be pleased to respond to any questions, either orally, or later in writing for the record.

The letter inviting our appearance at this hearing raises a number of questions, and this testimony will address each of them. However, I would like to begin by briefly discussing AASHTO and its process in the development of voluntary design, construction and inspection standards for highway structures. I believe this background might assist in establishing a useful context for my remarks on your specific questions and also serve such a role with respect to the comments of other witnesses as well who may make reference to "AASHTO Standards."

Development of AASHTO Standards

One of AASHTO's roles is, indeed, the development and promulgation of voluntary technical standards guiding the planning, design, construction and operation of highways and their appurtenances, including bridges and structures. The comparison of early highway building and operating experiences in the several states and the establishment of norms and standards through these experiences and through practical related research was, indeed, an important reason for the formation of AASHTO, then called AASHO, back in 1914. This practice of assembling, organizing and then promulgating the continually growing body of knowledge which we term highway engineering continues as one of AASHTO's most strenuous and vital activities.

Mr. Chairman, it may be helpful for me to briefly review how the Association conducts its voluntary technical standard activity.

The principal origin of our work in the development and refinement of technical highway engineering standards is our Subcommittees under the Standing Committee on Highways. Most of these Subcommittees consist of the chief official in each of our member departments having responsibility for the subject in question in his or her respective state. In the case of bridges and structures, for example, the Highway Subcommittee on Bridges and Structures consists of the chief bridge engineer in each of the fifty-two member agencies of AASHTO.

Through a system of individual effort, task force activities and requested research, suggested changes, additions and deletions to the several AASHTO published technical documents under the Subcommittee's jurisdiction are developed and proposed for consideration. To be adopted by AASHTO, proposed voluntary standards undergo a balloting process.

An affirmative vote by a two-thirds majority of the Subcommittee is required to approve a recommended standard. The approved document is then referred to the Standing Committee on Highways for consideration, and if the Standing Committee approves it, it will then forward the document to the AASHTO Executive Committee. If the document has the status of a technical policy, after approval by the Executive Committee it is finally taken up by our Policy Committee, which is the supreme committee of AASHTO consisting of the chief administrative officers of the fifty-two member agencies. At all these levels, a two-thirds majority requirement is maintained for approval. The result is a process which thoroughly but deliberately advances the state-of-the-art of highway engineering, maintains a national-level perspective, and recognizes that engineering is simultaneously both an art and a science.

Relevant AASHTO Documents

The documents maintained by AASHTO in the area of bridges and structures include Standard Specifications for Highway Bridges, which is modified and updated each year through an "interim" publication process, Manual for Maintenance Inspection of Bridges, which contains our recommended procedures and frequencies for inspecting the half-million plus bridges in this country for functional adequacy and safety, and some nine or ten lesser standards and guides related to various aspects of highway bridges and structures. With respect to the yearly interim changes to the Standard Specifications for Highway Bridges, AASHTO has delegated the responsibility for approving the annual changes to the Highway Subcommittee on Bridges and Structures, but the two-thirds affirmative vote is still required.

It needs to be noted that AASHTO's voluntary standard and policy documents are not themselves binding upon the states, since the Association has no legal power to this effect. It is up to each individual state to consider the AASHTO recommendations, and take appropriate action thereon. In some instances the AASHTO document is simply adopted by the state, and in other instances the state might use it as the basis for developing its own standard. In the instance of certain major publications, the Federal Highway Administration may go through a rulemaking procedure, based on an AASHTO document. In most cases, the FHWA will review AASHTO documents, and if they find them acceptable will list them as being suitable for use on federal-aid highway projects.

AASHTO's Views on the NPRM

Mr. Chairman, your letter requests information on AASHTO's policy position on the Federal Highway Administration's April 7 Notice of Proposed Rulemaking on National Bridge Inspection Standards. I must say at the outset that AASHTO's Policy Committee has not developed and adopted a formal policy position on the proposed rule. AASHTO's policy development process is both deliberative and--purposefully--deliberate. The time frame of the normal Federal rulemaking procedure, as well as the necessary level of detail attendant to such a procedure, both do not lend themselves well to AASHTO's formal process for policy development at the Policy Committee level which is generally more suitable to broader statements of principle.

AASHTO's role on Federal rulemaking is usually to promptly draw the attention of its member departments to proposed rules which might affect them in one way or another, and to thereby encourage their direct response to the public docket if and as they individually see fit. In cases where a proposed rule touches on previously established policies taken by the Association, a letter from AASHTO to the docket expressing those policies in the context of the proposed rule is frequently submitted. No such letter was so submitted in this case.

However, even though we have no formal association policies on the elements of the proposed rule, I believe we can properly comment on them. For one thing, through authority granted by longstanding action by the Policy Committee, the Subcommittee on Bridges and Structures is empowered to amend AASHTO technical guides and policies each year though the normal two-thirds affirmative vote of the Subcommittee's members, i.e. the chief bridge engineer in each of our fifty-two member departments. As will be described later, in approving the 1984 Interim to the Standard Specifications for Highway Bridges, the Subcommittee amended the Manual for Maintenance Inspection of Bridges in a manner such that the substance of the NPRM on the frequency of bridge inspections is in parallel. Beyond this, some thirty-two of our member departments submitted formal responses to the docket, and I am broadly familiar with the content of this public record. Finally, as a member and long time participant in the Subcommittee on Bridges and Structures, and Chairman, Technical Committee on Bridge Replacement Surveys and Inspection Standards, I am quite familiar with the day-to-day problems and resulting postures and sentiments of our bridge engineers on most bridge inspection issues.

Bridge Inspection Frequency

Mr. Chairman, as with many issues, AASHTO's members are not unanimous in their views with respect to the proposed change in the bridge inspection frequency requirements. Some, indeed, have urged FHWA to retain their current two-year frequency requirement for all bridges. Most states, however, more than 80 percent of those responding to the docket, felt that the proposed change was sensible and welcome. The proposed rule simply would allow state highway agencies to submit to FHWA for approval their recommendation as to groups or categories of bridges which might be inspected at intervals greater than two years. Such approval would be conditioned on documented analysis with supporting data and would consider such factors as past experience with the bridge or group of bridges; age; known condition of its members, components and in total; the type and frequency, and hence the live load stress, that the bridge is subject to; and any other relevant factors which might impact on safety. Only after review of such documented analysis would approval for an increased inspection interval period be granted together with any restriction or limitations of the approval. Once approved, and given the computer capabilities available today, it is as simple as adding a field in NBIS data base submitted by the states.

The most recent complete revision of *Maintenance Inspection of Bridges* was in 1983. In approving the 1984 Interim, the following language was added under "Section 2.3 Frequency of Inspection" by the Subcommittee on Bridges and Structures: "Each bridge is to be inspected at regular intervals not to exceed two years by personnel having the necessary qualifications as previously stated. *However, the maximum inspection interval may be increased and/or the depth of the inspection may vary for certain types or groups of bridges where such action is justified by past inspection reports and favorable experience and analysis*." (New wording underlined)

An effect of a rigid, unmodifiable two-year inspection frequency is for inspection teams to inspect some bridges--new structures and box culverts are cited as well-known examples--in which the likelihood of uncovering a defect or flaw is extremely low. Inspecting such a bridge necessarily dilutes the finite bridge inspection resources of any bridge agency. Such resources, consisting most preciously of limited skilled manpower, could contribute more effectively to safety, in terms of the number of repairable flaws recognized and scheduled for repair, or weight restriction postings recommended and placed, if they were somewhat more focussed on the bridges more likely to exhibit problems and less on those with a much lower likelihood of such problems. That, it would seem, is not only more cost-effective, it is just plain more effective in terms of potential collapses averted and potential lives saved.

One of the critics of this introduction by the Federal Highway Administration of considered flexibility in place of inspection schedules rigidity expresses concern that such a change would somehow detract from neatly summed columns of numbers in reports to the Congress by the FHWA on the bridge inspection program. With an assigned and approved frequency of inspection for each bridge the FHWA can still adequately produce accurate and informative tabular information in such reports, regardless of the inspection interval regulation. Beyond this, I believe most of us would find it difficult to assuage the frustration of a competent and prideful bridge inspection crew that they are "going through the motions" on a six-year old bridge with a well-established redundant design so as to promote the cause of neatly columned national numbers, when they know full well that there are other bridges that should be receiving greater attention.

Underwater Inspection Interval

In 1986, following the procedure outlined earlier, AASHTO adopted a new specification on underwater inspection. A key passage in the adopted change is as follows:

> "Underwater inspection shall be considered for those structures where the depth of water prohibits a visible inspection of the substructure. This will normally be required at intervals not to exceed five years, unless the Inspection Agency has documented data to support intervals greater than this period."

Language was also adopted stating in part,

> "Underwater inspection is the combined effort of sounding to locate the channel bottom, probing to determine deterioration and losses, and/or diving to visually inspect and measure bridge components. It should be an integral part of a bridge inspection plan. Permanently submerged structural, foundation and other components should be inspected when there is reason to believe that a problem exists."

Other changes included special reference to possible corrosion damage on steel or concrete-encased steel piles in brackish or polluted waters. This strengthened language concerning underwater bridge inspection will appear in our next bridge Interim publication.

All aspects of the condition of structural elements located in underwater environments are of considerable interest to our members at this time, and they will occupy the attention of the Subcommittee in all of its future deliberations. At this time, it is the considered judgement of the Subcommittee that a nominal five-year frequency of underwater substructure element inspection represents a reasonable engineering approach to insuring safety of the underwater elements.

Bridge Inventory Maintenance

There has been some difficulty in some states in updating the bridge inventory information to reflect load restrictions and postings on a timely basis. Mr. Chairman, I would like to remind the members of your Subcommittee that only a portion of the Nation's bridges are owned and operated by the states and, therefore, are directly under the control of AASHTO's member departments (in several states it is less than 1/2). By and large, bridges on the Federal Aid Primary system, as well as some others, are owned by state departments of transportation or highway departments. However, most bridges on secondary and tertiary roads and within municipal boundaries are under the ownership and operating responsibility of counties, cities, towns and villages, even though they may be located on a Federal Aid route. Beyond this, many bridges on functionally high level highway systems are under the control of toll authorities and/or other special districts or authorities, and thus are not the direct responsibility of the state transportation agency. Finally, of course, some bridges are directly owned and operated by various federal agencies.

In spite of the diffusion of ownership and operating responsibilities, the Federal Highway Administration looks to AASHTO's members exclusively for bridge inventory information and for enforcement of posting and closing recommendations. We do not object to this; this is the way it should be. Many of our members have entered into special arrangements with other bridge-owning authorities and have undertaken the tasks of inspection, maintenance, and other operating responsibilities. However, most of these bridges are operated by the owning agency. The only vehicle that most states have to enforce compliance is the ability to withhold federal funds.

Given the nature of intergovernmental relations, Mr. Chairman, it is not always possible to assure prompt compliance by all bridge-owning authorities with the requests and recommendations of our member departments. Some of our members have had the disconcerting experience of learning that load restricting signs placed on local bridges had been removed. This is, fortunately, a rather rare occurrence. None-the-less, it will be difficult for many of our members to comport with the 90-day limitation on updating the bridge inventory as contained in the Proposed Rule. A somewhat longer interval--say, 180 days--might be more attainable, at little or no increased risk.

Inspection Data Supplied by Federal Agencies

Mr. Chairman, as you are aware, some bridges in the U.S. are directly owned and operated by federal agencies including the Department of Interior, Department of Agriculture, TVA and others. In the same fashion as local government entities, these agencies are asked to report on their inspections and on any load postings as other inventory changes to our member departments so that they, in turn, can submit bridge inventory data to the Federal Highway Administration, as required by law.

Like local units of government, federal bridge-owning agencies vary in their degree of comportment with federal bridge inspection reporting requirements. In one state, for example, three years ago the compliance level for the federal agencies was less than 50 percent, and had remained at more or less that level for several years. However, in response to a vigorous special program seeking compliance, the rate of federal bridges not in compliance is currently in the 5 to 10 percent range.

Like many things, the compliance level is in part a function of the attention given the issue, and the compliance level by federal agencies rises and falls over a wide range at any given point in time.

Impact of Bridges Built in the 1950's and 1960's

As a result of first the post war boom in toll road development and later the advent of the Interstate Highway system, a much larger than normal number of bridges were built each year in the late 1950's and early 1960's. In addition to their larger number, these bridges were physically larger than the average. Thus, when the number of bridges constructed during these years is expressed in terms of bridge deck area, their quantity is even larger proportionally. An earlier bridge building boom took place toward the end of the Depression in the late 1930's in many locations. In Pennsylvania, for instance, about 1/3 of the current inventory of bridges were built in the mid- to late 1930's, 1/3 during the late 1950's and 1960's, and the remaining 1/3 constitutes all remaining bridges. Expressed in terms of bridge deck area, approximately half of Pennsylvania's inventory was built about 20-25 years ago.

In terms of the impact of this "bridge bulge" in the next five to ten years, the simple increase in the number of aging bridges will undoubtedly cause a proportional increase in the levels of bridge maintenance, and also in bridge rehabilitation and replacement work.

Beyond this, bridges built with steel superstructures and with fatigue-prone details may be expected to further add required maintenance and rehabilitation effort in this time period, because of the more frequent than planned applications of fatigue-causing loads. In all areas of the nation, of course, truck axle loads are somewhat heavier than usually projected 25 years ago. Also, axle load applications are occurring much more frequently than forecast in most areas of the nation, due to the rapid growth in truck volumes. Since fatigue is a function of the number of stress cycles applied to a bridge, we feel that maintenance and rehabilitation activities caused by fatigue-prone bridge details will grow more rapidly in areas of the nation where these bridges are more common, generally the northeast and southeast.

Preventive vs. Corrective Maintenance

While all inspectors are always on the alert for maintenance problems, an effective bridge maintenance program must be based on a sound management philosophy, (i.e., a regular painting program, cleaning of deck joints, bearings, etc.) When discussing bridge maintenance work, it needs to be remembered that the Federal Bridge Program does not now fund maintenance of any sort. No federal money is allocated for maintenance; only for replacement and rehabilitation. Where the jurisdiction owning a bridge is short of funds, there thus can be a tendency toward minimizing maintenance activity and concentrating instead on obtaining federal replacement or rehabilitation funds.

It is difficult to distinguish between preventive and corrective maintenance, since a well conducted bridge inspection program of the kind commonly conducted by our member departments will inevitably lead to both kinds of activities. Perhaps two of the most important preventative bridge maintenance activities is the cleaning and lubrication of all bearings, i.e. those points where the superstructure and substructure come into contact, and the cleaning and repair of expansion devices which accommodate the temperature-related expansion and contraction of bridge components. Another important item is to inspect and clean scuppers and other elements of the bridge draining system. Attending to such elements is natural for well trained bridge inspection personnel.

AASHTO philosophy is to develop design standards which reduce the need for preventive maintenance and/or future maintenance costs.

Mr. Chairman, it has been my pleasure to share these thoughts with you on bridge inspection and its effect on bridge safety in the U.S. I would be pleased to respond to your questions.

Thank you.

STATEMENT OF

JOHN K. MLADINOV, EXECUTIVE DEPUTY COMMISSIONER

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

ON BRIDGE INSPECTION AND BRIDGE SAFETY

PRESENTED TO THE

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

OF THE

HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

December 1, 1987

We appreciate this opportunity to appear before the Subcommittee and to speak of our experience and views on bridge inspection and bridge safety.

Schoharie Creek Bridge

You specifically asked that we address the circumstances surrounding the collapse of the Schoharie Creek Bridge and what subsequent changes were made to New York's bridge inspection program as a result of the collapse. The collapse occurred without warning during a major flood that exceeded the maximum rate of flow that had been anticipated by the bridge designers. The bridge had previously withstood an earlier flood that exceeded the April, 1987 flood.

Shortly after the collapse, the Thruway Authority retained a firm which specializes in investigations of engineering failures to analyze the collapse of the Schoharie Creek Bridge. The firm's preliminary report was completed in June so that it would provide guidance in the design for the replacement bridge. The firm's final report should be completed shortly. The firm's general conclusion is that the collapse occurred because of extensive undermining due to scour under one of the piers located in the streambed. The piers were on footings founded at a relatively shallow depth, on a hard compacted glacial till characterized by the consulting soils engineer as "soft rock". The design called for riprap for the protection of the piers in the water but there is some question whether the riprap was placed in accord with the apparent intent of the original design drawings, but the drawings are ambiguous.

Relation of Authorities to the State Department of Transportation

In considering the collapse of the Thruway Bridge, it is important to note that the New York State Thruway Authority is an independent governmental public benefit corporation, independent of the State Department of Transportation. Construction of the Thruway, a part of the Interstate Highway System, was financed by the sale of $1 billion of revenue bonds, with toll revenues servicing that debt. The bonds will be retired in 1996. The State DOT does not have jurisdiction over the Thruway Authority, but for purposes of bridge inspection, the Authority has voluntarily agreed to inspect its bridges following the provisions of Federal law and regulations and report the inspection results to the State DOT. While the New York State Thruway Authority and other authorities in the State are inspecting their bridges and reporting the results, the facts are that no authority is under a legal obligation to do so. In meeting the provisions of Federal law and regulations which require the State to inspect all public highway bridges in the State or suffer a loss of Federal bridge funding, the State is dependent on the continuing voluntary cooperation of the authorities.

This situation is proposed to be addressed by State legislation that would mandate that all authorities inspect all bridges under their jurisdiction in accordance with the standards established by the Federal Highway Administration and the State Department of Transportation.

Inspection Changes as a Results of the Collapse

As a result of the bridge collapse, the Department of Transportation has improved, modified and adjusted bridge inspection procedures in the following ways:

- The inspection of bridges over water bodies are scheduled for periods of low water in order to maximize the ability to visually inspect the above water substructure and to probe the foundations for possible voids. This serves to also maximize the number of substructure and channel inspections which can be routinely performed and documented, and it substantially improves the ability to document the streambed characteristics and profile so as to detect possible erosion and scour that may be taking place. This will also minimize the need for diving inspections;

- Where a structure's piers, footings or foundation are underwater and not visible, even during low water, a follow-up diving inspection is required;

- Procedural steps have been taken to assure that inspection reports will be rejected if they do not conform to the above criteria.

- For bridges with spread footings in a streambed, such as was the case for the Schoharie Creek Bridge, independent provisions and schedules for inspection are being established which consider stream and stream bed conditions, spread footing design and scour susceptibility.

- For bridges over water bodies, we are developing provisions for a separate hydraulic evaluation, including consideration of possible changed upstream or downstream conditions since the bridge was originally constructed, and a comparison of current and predicted water flow levels to those used in developing the original design.

- Immediately upon flooding conditions, a program of emergency profile checks is triggered for every bridge over waterways experiencing flood conditions. These checks are to detect whether there is any bridge movement or potential settlement, and, if so, immediate closure of the bridge takes place. If a bridge appears to be particularly vulnerable but may not have yet shown any movement, a round the clock watch is put into place at the site. Following the flood, inspections of the piers, footings and foundations are made to determine whether there has been erosion, scour or other damage that should be corrected.

While we are making these improvements to our inspection program, we are justly proud of our bridge inspection program, and, indeed, the Federal government has counted it among the best in the nation. But what is good can be made better and we are doing just that.

By the same token, immediately after the Mianus River bridge collapse, we also undertook immediate and longer term actions for bridges of similar design. Fortunately, we had earlier identified the potential for problems with bridges of this design and had already taken a number of remedial actions to avoid the potential for similar bridge collapses. However, we had not yet completed the effort at the time the Mianus River bridge collapsed.

We are spending about $16 million a year on the bridge inspection program, using ever more sophisticated techniques and equipment to determine bridge conditions, identify necessary maintenance and rehabilitation needs and to determine safe load levels for each bridge, given its condition.

Here in my hand is the State's bridge inspection manual. It is detailed, fully illustrated and contains exact specifications by which ratings are determined. Photographs and diagrams show what the inspection of each feature of the bridge should look for and how to rate it.

Our manual and our rating forms are much more detailed than the Federal manual and forms. We use a computerized weighting system to determine, on the basis of the separate rating for the many individual elements of the bridge, a single overall condition rating for the bridge. This computerized rating complements the judgment of the licensed professional engineers who head each of our 25 bridge inspection teams.

We use state-of-the-art equipment, such as ultra sonic thickness gauges, and articulated "snooper" trucks, which can swing their inspection platforms around and under the superstructure of a bridge to give the engineer-inspectors a close up look at the underside and support structure.

To probe beneath the surface of the water, our engineers use a long metal pole, rather like a dentist's explorer pick, to determine whether there has been water scour or erosion, and, if so, its extent.

Detailed underwater inspections by divers are covering the entire state. Diver inspections had previously been carried out on a selective basis, but they have more recently been put on a regular basis.

FHWA Proposed Rule Making on Bridge Inspections

You asked that I comment on the Federal Highway Administration's April 7, 1987 Notice of Proposed Rule Making on "National Bridge Inspection Standards"

It was ironic that only two days after the collapse of the Schoharie Creek Bridge, publication of the Federal Highway Administration Proposed Rule Making on "National Bridge Inspection Standards" occurred. The notice suggested that perhaps certain bridges were being inspected too frequently and that the time interval between inspections of such bridges should be increased beyond the two year maximum specified in the present regulation.

In our comments to the Docket we took the position that we do not object to FHWA's proposed modification to the current requirements for a maximum bridge inspection interval of two years, under certain approved conditions. We pointed out that New York State might not choose to exercise such an option since the State has a very large, and old bridge population, which faces some of the most severe environmental conditions in the country, requiring the frequent use of road deicing salts.
Many of our bridges are stream crossings that frequently must endure ice and heavy spring runoffs, exposing them to repeated high stream levels and potential embankment and stream bed erosion or scour. Under these conditions we would not be comfortable increasing the maximum interval between inspections.

In our response we recognized that conditions in other states may be sufficiently different to justify a longer inspection interval and there may be certain types of bridges which are less susceptible to deterioration and, particularly, to failure, which would justify a longer inspection interval. The potential candidates for lengthened inspection intervals would tend to be those that are newer, easiest to inspect, have redundant structural members and are not exposed to hostile environmental influences.

In our response we also pointed out that New York State already implements variable bridge inspection intervals within the two-year maximum inspection interval. An annual interval, or even less, is applied to bridges whose conditions warrant more frequent inspections so as to more closely monitor the bridge's condition and its deterioration. In general, in New York State, all bridges with low condition ratings, all load posted bridges, and bridges "flagged" for having serious structural deficiencies are inspected at no longer than one-year intervals.

With regard to the suggested five year underwater diver inspection interval, we commented that, having a variable cycle for underwater diver inspections, depending on the particular bridge and its design, conditions and environment is in line with the philosophy being proposed for general inspections, and also parallels New York State's philosophy for setting inspection intervals. Diver inspections are appropriate candidates for variable frequencies.

You also asked that we comment specifically on what impact on oversight and safety we believe can be expected if the current two-year bridge inspection frequency is lengthened.

We would expect no impact on oversight and safety in New York State since an annual interval, or less, is used for bridges where conditions warrant. However, I'm in no position to estimate how the proposed rule might be implemented elsewhere in the country and what effect that might have on safety. The proposed rule would require FHWA approval of any plan to change inspection frequencies from the present system but it's difficult to foresee how FHWA would be in a better position to judge the states' submissions than the states themselves. Certainly the concept of more cost effectively using inspection staff and funding resources so the more deterioration prone, and non redundant, bridges can get increased attention cannot be argued with. The question is how well can we accurately identify those that are so prone and those that are not. In any event, in New York, we do not expect to opt to exceed the two-year bridge inspection frequency. Possibly, after additional experience and effort, those bridge elements more susceptible to problems could be identified and given more frequent inspections while other elements not susceptible to problems could be inspected at longer intervals. The latter, in particular, could apply to those structural elements with considerable redundancy. While we have already given consideration to such an approach to inspections, thus far we have concluded that the increment of time necessary to inspect all of the remaining elements of the bridge is relatively minor since so much time is consumed in getting to the site, setting up, controlling traffic, gaining access to the structure and then removing all equipment.

As for how underwater inspection is carried out in New York and whether the current five-year interval recommended for underwater inspection is adequate, it is necessary to point out that underwater inspections are carried out as part of every regular inspection and not just at five-year intervals.

The Department of Transportation in New York conducts underwater inspections for more than 12,000 highway bridges spanning rivers, lakes and streams in the State. In most cases low water levels during certain times of the year allow the underwater portions of the substructure and adjacent stream bottom to be accessed by foot or small boat, and the inspection consists of visual observations, probings and stream bottom soundings. In deeper water, diver inspections are conducted, the frequency of which is determined by the conditions. The Department conducted diver inspections on 80 bridges between 1983 and 1986, and on 45 bridges in early 1987, not counting authority bridges. Nearly all these bridges are in the New York City and Long Island areas. A diver inspection program is currently underway for about 600 upstate bridges whose footings have not been accessible during regular inspections.

The leading causes of bridge failure are those attributed to hydraulic reasons, including flood and ice damage, scour and erosion. Underwater substructures are also susceptible to deterioration for reasons other than erosion. Salt water in particular can accelerate deterioration of steel and concrete, and timber components are susceptible to rot at the water line and attack by marine organisms. Underwater inspections are therefore needed to both assess the integrity of the structure itself and evaluate conditions of the supporting foundation material.

Bridge Load Rating and Posting

One of the issues nationally, as well as in New York State, is the matter of bridges that should be load restricted that are not shown on the national bridge inventory as being properly load posted.

The New York State Department of Transportation is implementing a plan to produce timely and accurate load ratings for both those bridges the State is responsible for, and for non-State system bridges. This effort is using to the fullest extent our inhouse load rating analysis computer program using the structural data collected during regular bridge inspections.

For State system highway bridges, we are load rating them on a priority basis, the priority being determined by the susceptibility the bridge has to needing a load posting. The priorities were set based on existing posting, structural condition, design load and age. Load rating tasks, consisting of an indepth computer analysis, engineering review and supplementary calculation, are underway. We have identified about 600 State bridges to be priority rated. This should include all bridges that will require a load posting as well as those bridges that are restricted from use by vehicles operating with an overload permit. The ratings and posting evaluations for these priority bridges should be completed by May, 1988.

An estimated additional 4,850 State system bridges are being load rated using the load rating analysis computer program. Any bridges shown to be load capacity deficient by this analysis will receive a supplemental engineering evaluation to verify the validity of the computer load rating and to then determine the appropriate load posting value, if one is found necessary. Since we expect that the priority State bridges will include nearly all load deficient bridges, there should be few of these remaining State bridges requiring supplemental evaluation, and very few requiring a load posting.

A remaining 1,600 State system bridges are culverts, arches, concrete frame structures and other unusual structure types which do not lend themselves to computer analysis. They undergo an engineering review based on such factors as structure type, design load, year built, length and condition.

Ratings for about 7,500 non-State highway bridges are being produced on a county by county basis using the load rating analysis computer program. An additional 2,800 non-State bridges are structures which do not lend themselves to computer analysis, and which are being rated through the same engineering review process as is being used for State bridges of these types. The issue of load posting is being addressed as follows:

1. Detailed computer analysis and engineering review outputs and summary listings of rating results are distributed to the owner of each bridge, along with a commentary on the purpose and limitations of the computer analysis.

2. A comparison listing of computer and engineering review results, and the existing load postings shown on the bridge inventory file, is produced, which identifies those bridges that should be posted or are not properly posted based on the rating values. We require the bridge owner to address these situations on an individual basis and report any modifications to ratings and/or load posting to the Department. A procedure for bridge owners to report to the Department the rating values based on their own analysis and/or revisions to load postings is also included.

3. The submission makes bridge owners aware of the requirements of the National Bridge Inspection Standards (NBIS) regarding rating and posting. Specifically, they are told that unless they provide us with properly documented analysis results of their own, the computer program load rating analysis or engineering review results will be those that are reported to FHWA for inclusion in the National Bridge Inventory, and an evaluation of compliance with NBIS for each local agency will be made based on this data.

We are confident that this approach will produce effective results in meeting our objectives, the local needs and the Federal requirements for rating and posting. Our load rating analysis computer program produces analyses of comparable quality to the AASHTO BARS Program, and it will provide meaningful results to bridge owners. We expect this effort will show substantially complete NBIS compliance on the May, 1988 Federal tape. We believe this schedule is reasonable considering the numbers of ratings to be processed.

Federal Agency Bridges

Federal agencies in New York State with bridges under their jurisdiction have agreed to supply the Department with bridge inspection data on a regular basis, and in a format which is compatible with New York's Bridge Inventory and Inspection System. Of 8 Federal bridges in the State, data has been provided for 3; data on the remaining 5 is being prepared.

State DOT Authority

It should be recognized that the Department does not have the authority to require State authorities, local governments, or Federal agencies to provide us with bridge inspection data to our standards or the Federal standards, nor can the Department require them to load post or repair bridges. In the past few years, there have been instances in which bridges under the jurisdiction of a municipality have collapsed, not only causing great inconvenience to the local population, but more importantly resulting in at least one fatality. Currently, there is no requirement in State law for a municipality to either close or place a load limit on a bridge which has been determined to be structurally unsound or weakened. However, the responsibility for such closure or load posting rests with the municipality having the jurisdictional responsibility for the bridge. On an emergency basis, law enforcement agencies in the State have the authority to close a bridge which is determined to be unsafe. We have instituted a procedure for instances when the local government fails to take the necessary measures to protect the public interest. In these instances, we call upon the State Police to close the bridge pending action by the local government.

Rate of Future Deterioration

It has been long recognized that the bridges built during the years that highway construction was proceeding at a high rate were approaching the age when they would be requiring rehabilitation work to address the effects of age, use and deterioration. About 2,200 State bridges were built in the 1960's when construction of new bridges was at a high point.

Bridges that are 25 or more years old are reaching a point that they will become deficient at an accelerating rate. They will require major expenditures to restore them to a non-deficient condition. New York has been experiencing this situation in recent years when, despite a major and rapidly growing bridge rehabilitation and replacement program, the number of deficient bridges has, nonetheless grown larger each year. We have instituted a preventive maintenance program aimed at catching deterioration at an early stage and addressing it before further deterioration makes it necessary to carry out costly rehabilitation.

I'm sure that over the last 10 to 15 years, every State, New York included, experienced a reduction of maintenance funding in terms of real dollars, at a time of accelerating bridge deterioration and an increase in the number of structures in the system. In New York State, it was not possible to increase the bridge maintenance staffing and funding proportional to these escalating needs and the erosive effect of inflation. Therefore, the level of maintenance per bridge declined in real terms over the past two decades. New York State has taken action to increase the bridge maintenance effort, primarily from the perspective of reducing the long term, and much higher, capital costs.

As of April 1987, a total of 2,875 or 37% of the state-owned bridges in New York State were rated deficient, although only 89 were in the most severely deficient ratings. At current levels of funding for bridge maintenance, rehabilitation and replacement, and current estimates of the rate of bridge deterioration and of inflation, our computer models predict that we will have over 3,400 deficient bridges in 1992. We have proposed a program and financing actions for the Legislature to consider for both our capital and maintenance programs for bridges, that could reverse this direction and dramatically reduce the number of deficient New York State owned bridges by 1992.

The proposal puts a new emphasis on preventive maintenance, coupled with an increase in our bridge capital program, in order to reduce the number of State owned deficient bridges and in the long run reduce the size of the capital program for bridge rehabilitation and replacement. This strategy is targeted directly at the preventive maintenance of currently non-deficient structures and is based on the judgment that if properly maintained the Department can prevent those non-deficient bridges from deteriorating to a deficient condition. This proposal was based on close scrutiny of inspection reports on non-deficient bridges and the inspector's entries as to repairs necessary and their estimate of the quantity of various types of remedial work necessary. These estimates were checked in the field, with the results used as an input to the computer model used to project future conditions with and without such work being done.

Based on the current number of non-deficient state-owned bridges and the analysis of the maintenance needs of those structures to prevent further deterioration, we estimate that we need to increase our total corrective and preventive bridge maintenance effort by a factor of 2.6.

We recognize that maintenance alone cannot address or correct the structural deficiencies of bridges that currently require investment. However, using improved inspection, inventory and rating systems, we are able to quantify and project the impact of preventive maintenance on the future condition of the system. By combining a maintenance strategy, which prevents good bridges from becoming deficient, with a capital program which fixes deficient bridges at an increased rate, the Department could substantially reduce the number of deficient bridges and eliminate those that pose a safety hazard as a result of deterioration.

Federal-Aid Distribution Formulas

We believe that the formulas used to apportion the various categories of federal aid should reflect the relative needs of each state for each category of Federal aid. The factors used in the present formulas do not result in a distribution which accurately reflects the relative needs of the states. New York is particularly concerned with the formulas used to apportion Highway Bridge Replacement and Rehabilitation funds and Interstate 4R funds and their resulting distribution.

Highway Bridge Replacement and Rehabilitation funds are apportioned on the basis of a formula which reflects the relative costs of needed replacement and rehabilitation of deficient bridges in each state. From the data compiled and reported by FHWA for 1986, New York State has about $4 billion of needs in deficient bridges. This represents 18.1 percent of the FHWA-inventoried national needs. However, the present law limits the apportionment of bridge funds to any one state to only 10 percent of the amount authorized for apportionment. As a consequence, New York's apportionment was in excess of $120 million less then would be warranted by FHWA's evaluation of relative needs, the Congressionally established basis for distributing bridge funds. All of the other states share this amount as a bonus derived at New York's expense. New York is the only state affected by this limitation, and the Bridge Program is the only categorical highway program subject to an arbitrary maximum apportionment limitation. Under the reduced apportionments for Highway Bridge Replacement and Rehabilitation funds contained in the Surface Transportation and Uniform Relocation Assistance Act of 1987, the funding available to New York resulting from the combination of the reduction in program and the limit on the maximum amount available to any one state will make it impossible for New York to replace or rehabilitate bridges at a rate which would ever allow it to catch up to the condition of bridges which prevail in the rest of the nation.

To partially offset the loss of funds which New York would be entitled to receive based upon relative needs, we believe the arbitrary maximum limitation should be removed from the law, possibly by phasing in the change over a period of years so as to reduce the effect on the other states. As an example, increasing the cap to 12 percent would impact each other state by only 2 percent.

Nationally, about 48,000 or 19% of the bridges which are on federal-aid highways are a part of the the Interstate System. The 1987 Annual Report to Congress on the Highway Bridge Replacement and Rehabilitation (HBRR)

Program reports that on the basis of their condition, over 4,300 of these bridges are eligible for replacement or rehabilitation. Thousands of other Interstate bridges, although not eligible for replacement or full rehabilitation, are in need of work normally funded from the Interstate-4R (I4R) Program.

In addition to a substantial portion of the available national HBRR funds, in the five years 1982 through 1986 about $2.5 billion in I4R funds were spent for replacement or rehabilitation of Interstate bridges. Despite this additional funding, the number of Interstate bridges eligible for replacement and rehabilitation increased 37% over the period. The cost of replacing and rehabilitating these Interstate bridges is estimated by FHWA at $2.9 billion.

As the large number of Interstate bridges built in the 1950's and 1960's age, an increasingly large share of available I4R funds will be needed to address bridge problems. However, the formula for apportionment of I4R funds does not include any measure of the number or condition of Interstate bridges in each state. We suggest that Congress consider adding a factor to the formula keyed to providing an equitable funding level to correct the deficiencies of Interstate bridges. Further, consideration might also be given to providing priority in the allocating of discretionary I4R funds to high cost projects needed to rehabilitate or replace Interstate bridges.

I thank you again for this opportunity to testify on this matter of great public and personal concern in the hope that it will lead to improvements in the nation's bridges and the bridge inspection system.

TESTIMONY BEFORE SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

OF THE

HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

DECEMBER 1, 1987

Good morning, ladies and gentlemen. My name is J. William Burns and I am the Commissioner of the Connecticut Department of Transportation.

I am pleased to testify this morning before your Subcommittee on some of the lessons learned as a result of the Mianus River Bridge collapse on June 28, 1983.

I am not going to dwell on the cause of the collapse other than to say that we hired the foremost expert in the Country on structural failures who concluded that the design of the bridge made it inevitable that a collapse would occur. It was also concluded that disassembling parts of the bridge would be the only way an inspection could have predicted this failure. I completely disagree with the National Transportation Safety Board's conclusion that lack of proper maintenance was the cause.

I do want to point out that in each of the years prior to the collapse of the Mianus, the Federal Highway Administration reviewed the adequacy of Connecticut's bridge inspection program and issued favorable reports in each instance.

On August 2, 1983, approximately one month after the collapse, I initiated an internal review of the Department's bridge inspection procedures and policies. The purpose of that review was not only to look into the inspections of the Mianus River Bridge but also the entire process of inspecting bridges in Connecticut.

This investigation included:

- Qualifications of bridge inspectors.
- Training and instruction of bridge inspectors.
- Staffing and assignments of bridge inspection unit.
- Conduct and reporting of bridge inspections.
- Followup after inspections.
- Maintenance and repair of bridges.

The September 1983 report of the findings of that review included 36 recommendations which have all been implemented. Subsequent to the issuance of this internal report, additional actions have been taken to strengthen Connecticut's bridge safety inspection program. This morning I would like to explain what I consider to be the most important of the recommendations:

ADDITIONAL INSPECTION TEAMS

Prior to the collapse of the Mianus River Bridge, there were six two-man inspection teams and an underwater inspection team for the 4800 bridges for which ConnDOT is responsible. These inspectors were essentially technicians up from the ranks of Maintenance and Construction trained by the Department to inspect bridges but not to perform engineering evaluations. When an engineering problem was discovered in the field by these inspectors, an office bridge engineer would be called out to determine the action necessary.

As a first step, two more inspection teams were added to reduce the workload from 800 bridges per year per team to 600. This allowed more thorough inspections of each bridge.

At the time the two inspection teams were added, two additional bridge engineers were hired to assist in the field when complex or problem bridges were inspected. Subsequently, four additional bridge engineers were hired to provide technical direction and supervision of the inspection teams.

Finally, ConnDOT contracted with two bridge engineering firms to perform the inspections of the 650 or so "complex" bridges (major river crossings, viaducts, and unusual designs) as well as to perform 10 year in-depth inspections of each complex and moderately complex bridge. By in-depth inspections I mean a "hands on" examination of all exposed parts of a bridge and additional non-destructive examinations (such as ultrasonic, magnetic particle and radiographic tests) as may be deemed necessary. The smaller, less complex bridges are still inspected by the original inspection teams.

ADDING INSPECTION INSTRUCTIONS TO DESIGN PLANS

With the multitude of new and different designs for bridges, it was recommended that all design plans for new bridges would include instructions on what inspectors should look for, especially fracture critical details and fatigue prone areas. The frequency and level of detail of the inspections are now noted on computer generated inspection schedule sheets.

In addition, it is now required that an engineer and an inspector from the Bridge Safety and Inspection Section review bridge design plans as they are being prepared to assure that the bridge can be adequately inspected. Particular items of interest include catwalks, doors into box girders, ladders, safety wires for beam walking, and accessibility of joints and bearings.

REPORTING AND FOLLOWUP

Upon receipt of the bridge inspection reports, the safety engineers would previously review the reports, field check problems noted by the inspectors, and recommend improvements. However, there was limited information maintained in the individual bridge file to indicate whether any maintenance or contract work was recommended, scheduled, or completed. All the inspections in the world would not amount to anything unless appropriate corrective action was taken.

As a result, a form was added to the bridge inspection file by the safety engineer to indicate those areas of the bridge to:

a) keep under observation,

b) further inspect in-depth on a specified date,

c) recommend repair to be done by District bridge maintenance forces with dates for start and completion noted, or

d) recommend improvements to be done by contract with dates for start and completion noted.

Requests for work by Maintenance must be in writing and Maintenance must respond in writing:

a) whether Maintenance can do the work,

b) if so, when the work is scheduled, and

c) when the work is completed.

In addition to notifying towns when a deficient local bridge over 20 feet long should be load restricted, ConnDOT also advises the towns of the corrective work that must be done to eliminate the load restriction. Because some towns are lax in posting load limits after being notified by ConnDOT, the Department issues news releases informing the general public of the legal loads that can cross a bridge.

TRAINING

Proper training of inspectors is essential to the success of any bridge inspection program.

In Connecticut after Mianus, training was intensified from four to five days every three years to annual training sessions of at least five days. The training sessions include field inspections of three different types of bridges which are rated independently by each inspector and the bridge safety engineers. The reports and ratings are then compared with differences discussed and resolved to the proper rating and level of detail desired by the bridge safety engineer.

This assures uniformity of ratings of the various elements of a bridge by each inspector.

CONNECTICUT'S POSITION ON PROPOSED RULEMAKING

I have been asked to comment on the Federal Highway Administration's April 7, 1987 Notice of Proposed Rulemaking "National Bridge Inspection Standards." My comments are as follows:

650.303 Inspection procedures

Connecticut already marks on our plans fracture critical details and other special features requiring additional attention during inspections, maintains a list of bridges which require more frequent inspections and also maintains a list of bridges requiring underwater inspections. We support the proposed additions which deal with these items.

650.305 Frequency of Inspection

The increase of the inspection interval is optional according to the revisions and we would hope that it remains that way and will not affect federal funding of inspection activities in the future. In our opinion, the maximum inspection intervals should not be increased over the presently specified two-year interval. Although less frequent inspections of culvert and newly completed structures might present less of an increase in risk to the traveling public than less frequent inspections of other categories of structures, some compromise of safety may occur. This compromise in safety is unacceptable to Connecticut.

Instead of increasing the inspection frequency up to four years as suggested, it is recommended that the individual states determine the degree of depth needed for each inspection. For instance, a short span concrete slab bridge or box culvert in good condition does not require the same detailed inspection as a bridge with a two girder and floorbeam system. Settlement undermining, or development of cracks would be discovered on such a structure in the two year inspection and corrected by routine maintenance. The same deficiencies could worsen during the four year inspection cycle and require repair by contractors or even develop into hazard for the traveling public.

650.307 Qualification of personnel

We support the alternate minimum qualifications for bridge inspection leaders. We do not agree that the duration of a comprehensive training course should be specified by the FHWA. Reviews of the various States' inspection organization and procedures which are conducted annually by the FHWA should determine if inspectors are qualified. Connecticut has at least one training course each year and quite often has additional training courses such as the course on Inspection of Fracture Critical Bridge Members sponsored by the FHWA. We feel that our inspectors are qualified to make day-to-day decisions regarding the safety and integrity of bridges. Field senior engineers are also available at all times to help in these decisions.

650.311 Inventory

Connecticut presently updates any significant changes in the inventory including placement of load restriction signs within 90 days. We support this revision.

IMPACT IF TWO YEAR BRIDGE INSPECTION FREQUENCY IS LENGTHENED

As noted above, Connecticut is not in favor of extending inspection frequency beyond two years. We have experienced several serious bridge safety problems that have developed between the two year inspection interval. A problem, even on a new bridge, if undetected could gradually worsen and become a critical safety problem.

In fact, we have had a few situations in Connecticut in the past two or three years where cracking of concrete was discovered during construction of new bridges. These problems were corrected prior to opening the bridges to the public which saved the complications and difficulties that would have resulted if the repairs had to be made under traffic or, worse, if traffic had to be detoured. A new bridge is no guarantee that there will be no problems or that no inspections are necessary for three or four years.

We feel strongly that the two year cycle should be retained but the level of detail of inspections on new bridges would not be the same as on older bridges. We would consider a greater-than-two-year inspection cycle as a sacrifice of safety.

UNDERWATER INSPECTIONS

Underwater inspections are currently being performed by consultants retained by the Department. Each dive team consists of a minimum of two divers, and the diving operation is in conformance with all OSHA regulations. The lead diver must be a graduate engineer, and the person responsible for the diving operation must be a registered Professional Engineer in the State of Connecticut. Underwater inspections are scheduled on a two-year inspection cycle, with additional inspections made following significant floods.

LOAD POSTINGS OF BRIDGES

The only problems in Connecticut regarding load postings of bridges are on some of the town bridges greater than 20 feet in length which are inspected by the Department. A few towns have responded slowly in posting bridges after being notified following an inspection and evaluation of the load carrying capacity of a bridge. ConnDOT does follow up both verbally and in writing with the towns if the appropriate postings are not in place. This happens only on some five or six of the 1200 town bridges inspected by the state and, therefore, is not considered to be a significant problem. The Department does warn the offending town of the possible loss of Federal Highway funding should they not properly post their deficient structures.

On state bridges, load postings or further reductions of already-restricted bridges are in place generally within no greater than a week from the establishment of the load limit by the bridge engineers.

FEDERAL BRIDGES

There are no bridges in Connecticut under the sole jurisdiction of any federal agency, thus, no inspections are made by federal agencies.

FUTURE DEFICIENT BRIDGES

In 1984, after more than a dozen years of deferred maintenance and general neglect due to lack of funding, Connecticut's Legislature approved Governor O'Neill's plan for a 10 year transportation program.

This legislation which established a dedicated transportation fund with periodic increases of the gas tax and other revenue sources throughout the ten year period, included over $1 billion for the repair and replacement of state bridges. It also included a local bridge program of over $340 million.

In addition to providing the funds necessary to repair or replace the 580 bridges known at that time to be in "fair" or "poor" condition, the program also anticipated, and provided funds to fix, another 110 bridges per year expected to be rated "poor".

In the first four years of the program, over 400 bridges have been rehabilitated. Another 800 are now on the drawing boards.

Fixing these bridges and bringing them up to standard load carrying capacities is expected to lessen the demand on the state's bridge inspection program. For example: all load-posted bridges are inspected every six months to check for further deterioration which could cause the load limit to be lowered. Once the bridge is fixed and the load restriction removed, the bridge would then be returned to a two-year cycle of inspections.

PREVENTIVE AND CORRECTIVE BRIDGE MAINTENANCE

As I noted above in the section entitled REPORTING AND FOLLOWUP, the bridge safety inspections lead directly to corrective and preventative maintenance.

In addition to the two-year bridge safety inspections, ConnDOT also carries out annual bridge maintenance inspections. These maintenance inspections are for the purpose of determining those maintenance actions to be taken to prevent a bridge from further deteriorating to the point where a safety problem will result.

Additional Department staffing for bridge maintenance operations has been implemented, and outside assistance has been obtained through the introduction of a bridge maintenance-by-contract program. We are currently considering reorganizing our bridge maintenance organization in order to provide better technical direction, improve staffing levels and skills, and expand equipment allocations for this vital task.

This concludes my testimony. Thank you for the opportunity to appear before your Subcommittee.

Mr. **Oberstar.** Our final witness today is Mr. Gerald Donaldson, Highway Safety director of the Center for Auto Safety.

Dr. Donaldson, would you identify your associate?

TESTIMONY OF GERALD A. DONALDSON, HIGHWAY SAFETY PROJECT DIRECTOR, CENTER FOR AUTO SAFETY, ACCOMPANIED BY HENRY JASNY, STAFF ATTORNEY FOR THE CENTER FOR AUTO SAFETY

[Witnesses sworn.]

Mr. **Oberstar.** You have very a complete statement pending before the subcommittee, the entire statement will appear in full in the record and you may summarize as you choose. I think you are familiar with the committee procedures.

Dr. **Donaldson.** Yes sir, I am, Mr. Chairman.

Mr. **Oberstar.** We want to thank you for the very careful and thorough analysis you have given to the questions the subcommittee has raised and for the detail of your presentation.

Dr. **Donaldson.** Thank you, Mr. Chairman.

I most certainly am not tempted in the least to test both the patience and appetite of the committee by wading through 26 pages of written testimony, and I know on both sides of the table that all of us would prefer to see a lot more bridge inspectors wading out to inspect bridge piers than my wading through this testimony.

Mr. Chairman, our national bridge program is in serious trouble. The safety of millions of Americans has been jeopardized by inept federal stewardship over our bridge inspection and rebuilding effort. The States have misspent millions of scarce Federal aid bridge dollars through dereliction of their responsibilities to the traveling public.

This sad, and sometimes tragic story, is not one that can be told only by neatly summed columns of numbers showing compliance with the National Bridge Inspection Standards, or by lists of obligational figures representing the States use of highway replacement and rehabilitation program funds. The failure of America's bridge program is a story of irresponsible State, county, and city management of nearly 600,000 bridges; of deferential FHWA division administrators whose bridge program philosophy has been go along, get along; of national policy choices made behind closed doors without public rulemaking; and of State control of inventory, inspection, posting and closing, maintenance, and bridge replacement project selection that has demonstrated a chronic, pervasive pattern of neglect and waste.

In the following pages, Mr. Chairman, I will survey the basic defects of our national bridge program and set out what we think ends to be done by this Congress, the Federal Highway Administration, and the States to put this program back on track.

One of the most fundamental defects of our bridge program is the persistent failure of the states to perform reliable, cost effective maintenance of our nation's bridges in compliance with Federal statutory responsibilities. Without rational maintenance management, without the efficient use of State and local funds to keep bridges in sound condition through timely applications of intelligence maintenance strategies, HBRRP funds are called into play too soon and too extensively.

Most States have virtually no bridge maintenance programs with specific quantified maintenance goals; no documented maintenance processes; no rationally planned aggressive strategies to arrest or slow bridge deterioration. Many states address maintenance deficiencies on an ad hoc basis and rely only on personal familiarity by certain highway staff with bridge maintenance problems. As a result, thousands of bridges at the State, county, and city levels are left in chronic derelict condition with unchecked corrosion, deteriorated decks in desperate need of routine periodic overlays, and unrepaired or obsolete NPRM railings with poor crashworthiness.

How can we expect any State, Mr. Chairman, to have an efficient, comprehensive NBIS effort and rational HBRRP project selection methods when this same State flies its bridge management effort by the seat of its pants?

Mr. Chairman, unless Congress directs the institution of Federally approved bridge maintenance procedures and performance goals as integral components of a comprehensive bridge management program, the States will continue to make hip pocket judgments on maintenance.

National bridge inspection standards. First thing that must be said here, Mr. Chairman, is that the trap of NBIS to be wary of is playing the numbers game. Tomorrow the FHWA will come before this subcommittee with neat lists of numbers showing incremental improvement each year in compliance by the States with the inventory, two year inspection cycle, and load rating/posting and closing requirements of 23 CFR part 650. These numbers are not reliable indicia of the quality of regulatory compliance even in many of those States where there has been significant affirmative in the wake of the Mianus bridge collapse and the Center's court action against the agency.

Many States are right now performing shoddy inspections with underqualified inspectors and inadequate equipment and techniques. These abuses accelerate when one moves to the local jurisdictional level. Many counties and cities are right now, for the very first time, inspecting thousands of structures that have never been inspected in living memory. Local officials continually soft pedal the quality of these inspections, particularly when inspection requires a bridge to be coded as deficient, thereby requiring interim inspections between the two-year cycle.

Equally often, these deficient bridges require the posting of loads lower than legally permitted State maximums. Thousands of bridges are just now being posted that should have been posted a year ago.

Except for a very few dissenting voices, the States are now crying out against the tepid efforts of the FHWA to enforce the two-year inspection cycle. In many States, the two year cycle was always honored only in the breach. The States as a whole in fact had a flexible inspection schedule due to lax federal enforcement.

Now the states claim burden when, for the first time, the Federal Government makes an effort to secure compliance and, as a consequence, they demand flexible inspection schedules that will exceed, even double, the two-year cycle now in effect. But one must ask, Mr. Chairman, how good is our national bridge program right now from all those years when the states could flout the two-year cycle with impunity?

Now we are told that legalizing this flexibility through an amended bridge regulation will ensure the cost effective use of Federal and State bridge dollars. How cost effective were the uses of these dollars in States that had never even made an effort to conform to a two-year inspection cycle since the inception of the NBIS 16 and one half years ago?

In many cases, these State bridge programs were a shambles. And we are now asked to believe that federally permitted flexibility will bring in the millennium, will reap tremendous benefits that ad hoc flexibility did not produce in the past?

In sum, Mr. Chairman, the variable inspection schedule proposal is a way for both FHWA and the States quickly to get out from under. We believe the proposal is really a divide and consumer tactic that invites abuse because the FHWA has consistently shown that it is incapable of monitoring and enforcing compliance on the two-year cycle. We think that it is highly probable that many States, currently prone to indulge a, let us say, unhurried approach to bridge inspection will suffer relapse on the partial gains made in the past couple of years.

We see no indication, Mr. Chairman, that the agency is planning a quantum leap in the extent or quality of oversight at any FHWA organizational level following a final rule on this docket. Moreover, if FHWA attempts to invest oversight responsibility for bridges under flexible inspection schedules in its division administrators, this is, in the first instance, the very management location for year to year administration of the NBIS that failed utterly to enforce the States conformity to Federal law and regulation.

Let's take a look at the most recent division administrators annual maintenance reports to FHWA headquarters. These reports require, in part, an annual fiscal year assessment of NBIS compliance. Despite the supposed high profile, high energy FHWA bridge management reform effort of the last two years, some divisions did not file any NBIS report. Others sent in their maintenance reports that are supposed to be completed by October 1 and sent on through the region to headquarters, in May of 1987. Still others that have States with the worse bridges programs, bad across the board, filed terse reports with vague assertions of state doing better, still having some difficulty with locals. To us, Mr. Chairman, these phlegmatic comments are dangerous signals of what to expect in the way of vigorous oversight and enforcement if a variable inspection schedule is put in place.

FHWA proclaims in its proposed rule that its implementation of a flexible schedule of inspections will result in only minimal or negligible increase in risk to the public. First, Mr. Chairman, it is a poignant, if not chilling note that the FHWA is compelled to admit that in order to legitimize the States noncompliance with the NBIS inspection cycle, a relaxation of the two year cycle will result in more lives lost and more injuries sustained.

One would have thought that the traveling public deserves better than this, having already suffered the loss of several lives in the collapse of the Schoharie Creek bridge only two days before the NPRM was published.

Second, we find nothing cited in this rulemaking proposal as a rational evaluation of the risks to the safety of the traveling public from a weakened NBIS, nor are we persuaded that, given the shambles that FHWA has allowed the NBIS to become since its start, safety will be not much different than it is now, is a pretty obvious and pretty lame post hoc rationalization and one that, on a personal level, I find blood chilling.

Lastly, it is currently a matter of record that States which have improved their bridge inspection cycle to conform to the two year requirement have shown not only the improved cost efficiencies that have resulted for their overall bridge programs, but have also radically lowered the potential for bridge collapses, especially when a vigorous underwater inspection effort has been instituted.

Alabama and Connecticut are two States, Mr. Chairman, that I must point out as favoring retention of the two year cycle. It must be emphasized that, until very recently, Alabama had one of the worst records of any State in complying with the requirements of NBIS. We all know the bridge disasters—Chickasawbogue Creek and Mianus—that occurred in these two States that evidently have played no small role in the willingness of the two States to go against the flow. Having bridges fall down because of incompetent bridge management is a terrible way to have to get true religion, Mr. Chairman, but it woke up these two States to the real world consequences of poor and infrequent bridge inspection.

We have just celebrated Thanksgiving, one of our country's most important holidays, Mr. Chairman, that confirms for us each year that we live in an open society.

So let's talk some turkey here about closed door policymaking, about our national bridge program where the regulatory apparatus for controlling the use of public funds for durable, safe bridges is produced outside of public view, without rulemaking, without notice to our participation by the public.

The Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges; the Manual for Maintenance of Bridges; the Bridge Inspector's Training Manual; and the Standard Specifications for Highway Bridges—these are the documents that are the guts of our national bridge program, documents that are authored and revised by FHWA and AASHTO in exclusive consultation, without public evaluation and critique, in violation of statutes created to control, to stop this kind of insulated utilization of one interest group's views as the preferred source of advice for agency polity.

It is long past time for the FHWA to bring these documents out into the Sunshine. The Manual for Maintenance Inspection of Bridges is cited as a requirement in 23 CFR Pt. 650—in a footnote. It has never been put through rulemaking.

The Standard Specifications for Highway Bridges is the design manual that delineates the construction techniques and materials, and counsels the engineering judgments to be used, in building and restoring bridges. Currently in its 12th full edition, with interim specifications issued recently, it is amended by AASHTO and FHWA without public participation through rulemaking.

The Bridge Inspector's Training Manual, which specified techniques, equipment, and training prerequisites and goals, never was put through rulemaking.

The Recording and Coding Guide, which selects the bridges features to inspect and how to weigh the results in the scales of structural integrity versus safety, the inventory and appraisal system that is the heart of the States decisions of what bridges to repair, which to replace, a new draft edition has just come out, Mr. Chairman, a joint production of FHWA and AASHTO alone.

And this, Mr. Chairman, is not the end of the story. We have all sorts of other regulations issued by the FHWA that never get near the Federal Register, much less entered in the CFR, that are laundered through internal memoranda to regions and divisions.

Did you or your staff know, for example, that FHWA has required each State to have a well founded underwater inspection program? Neither did we, until we uncovered a reference to it in records secured through the Freedom of Information Act request just a few months ago.

When was it issued as a Federal Register final rule? No, it was an internal memorandum from FHWA headquarters to its regions dated June 26, 1985. And by the way, Mr. Chairman, despite four FOIA requests in just the past year for bridge program records from FHWA, two of them alone on just the underwater inspection program, we still have not seen this memo. Instead of asking for public comment on the nature of improved underwater inspection programs in a Federal Register NPRM, FHWA preferred to establish State grantee requirements by casting the new responsibility into a management communication from one level of the agency to another.

It is time for closed door policy making in the bridge program to end, Mr. Chairman. It is time to open up the major controlling documents of the bridge program to the scrutiny of a wider professional public through public notice and comment rulemaking in the Federal Register. Let's open the doors and pull up the shades.

In conclusion, as we said at the outset of these remarks, Mr. Chairman, this bridge program is in serious trouble. A combination of tinkering with existing NBIS regulations, especially a weakening of the current two year inspection cycle, and FHWA trying to jawbone the States into better bridge programs, is just not enough. We think that Congress must ensure that at least the following major actions are undertaken in order to convert our national bridge program into an effective instrument for the safe and cost effective use of Federal aid bridge funds:

First, retain the two-year inspection cycle until sound research and field experience establishes other justifiable intervals that optimally generate inspection data that can ensure cost effective maintenance and HBRRP replacement/rehabilitation work, and moreoever, guarantee the safety of the traveling public.

Second, the NBIS must be improved especially with regard to the nature and quality of interim inspections of deficient bridges. FHWA must issue standards specifically geared to ensuring high quality, documented interim inspections.

Third, a national underwater inspection program must be produced at the Federal level that specifies the exact techniques, equipment, personnel qualifications and intervals required to ensure timely detection of underwater support deficiencies and their repair. This must be proposed for public evaluation in the Federal Register.

Fourth, the FHWA must produce a bridge management system model for use by each State and the agency must approve each State's BMS. Each approved BMS must include written criteria for all phases and processes of inventory, inspection, maintenance, personnel qualifications, HBRRP project selection, and post-project cost effective evaluation. The model generated by FHWA must be offered for public evaluation in the Federal Register.

Fifth, FHWA must issue maintenance performance standards that specify the goals of State maintenance of federally assisted bridges and set forth the management techniques and strategies that will achieve these goals to ensure compliance with 23 U.S.C. § 116. This must be offered as proposed rulemaking in the Federal Register.

Sixth, FHWA must mandate the present, or appropriately rulemaking modified, Federal NBI format of the recording and coding guide as a requirement for all jurisdictions to use when inventorying and inspecting bridges. Too much data is being lost in translating different State and local inventory and inspection forms into the federal format. In other words, the guide should be made a uniform Federal standard and amended through rulemaking.

Seventh, the other major FHWA/AASHTO documents itemized on page 20 of our testimony must be put through rulemaking so that a wider and more varied professional public can assess the adequacy of these centrally important manuals and standards.

Eighth, Congress must continue to keep all bridges 20 feet or more in length eligible for HBRRP, even given the currently reduced authorization figures. Removing entire classes of bridges from the HBRRP any time in the foreseeable future would produce a national public works disaster.

Ninth, Congress should seriously consider establishing specific statutory maintenance, NBIS, and HBRRP requirements for local jurisdictions given the reluctance and legal inability of many States to persuade or compel counties and cities to observe current bridge law and regulation.

And we also believe that very few if any of these recommendations will be acted on by the FHWA or the States absent the leadership and statutory command of this Congress. Tomorrow you will be presented testimony by FHWA that will down play all of these mistakes and failures and tell you to be patient, that compliance is a difficult thing to achieve and that the States are short of personnel, short of money, but are well intentioned and trying hard.

AASHTO will tell you that the States are eminently responsible in their bridge programs, that they are using both Federal and State bridge money effectively, that the safety of the traveling public is well in hand, and that freak accidents can happen despite the best of intentions and the best efforts.

They will tell you that they don't need bridge management systems to be mandated by FHWA, they don't need statutory maintenance goals, they can work out all the kinks with present regulations, no more is needed.

FHWA, not surprisingly, will second all of these AASHTO denials of need. The tale of the reluctant bridgegroom palls in comparison with FHWA, the reluctant, if not fearful regulator. Let's make no mistake about what this agency stands for, what its motives are in dealing with the festering problems of our national bridge program.

This is the agency, Mr. Chairman, that ineffectually administered a bridge program for years and years that was rife with chronic noncompliance and sustained abuse of Federal funds until the Center's suit and the collapse of the Mianus and Chickasawbogue Creek bridges jerked its head from the sand.

This is the agency that tried once before in 1983 to satisfy AASHTO's demands for a weakened Federal presence in the bridge program, an attempt that fell with the Mianus Bridge.

This is the agency that in 1985 trumpeted its so-called management overhaul of the bridge program while offering to this Public Works Committee in 1986 a legislative proposal that would have knocked 75 percent of the nation's bridges off the Federal HBRRP program and dump the safety of our citizens into the laps of the States, many of which had neither the manpower, the knowledge, or the money to improve bridge inspection, maintenance and rehabilitation.

This is the agency that on national television this past spring proclaims that the most recent major collapse was not due to human failures, not due to bad design, not due to irresponsible inspection and maintenance, but to inexorable, irresistible forces of nature.

This is the agency, Mr. Chairman, that expresses total astonishment and disbelief over the collapse of one great bridge after another, but who is a major participant in that subtle interplay of negligent management decisions, inept policy choices, and the many, many day to day sins of omission in overseeing our national bridge program in the field, that ultimately led to the collapse of a mighty bridge with its helpless human cargo into the surging floodwaters of Schoharie Creek on April 5, 1987.

That concludes my oral presentation, Mr. Chairman. We are willing to respond to any questions or comments.

Mr. **Oberstar**. Thank you very, very much for a forceful, well thought through presentation.

The Chair recognizes the time pressure of the gentleman from Pennsylvania. I would like to recognize him at this time for questions.

Mr. **Clinger**. Thank you very much.

Just a few questions.

Dr. Donaldson, the argument that is made for allowing states to extend the period of time to five years, for example, is that that would enable them to use limited resources to focus on the higher risk bridges that might get short shrift if they are required to inspect their every box culvert on a two year basis.

I gather you would reject that argument. I wondered if you would give us your reasons why you think it is so necessary to inspect every bridge on a rigid schedule?

Dr. **Donaldson**. I would have to divide the response, Mr. Clinger, because in principle, we are not opposed to the logic of wanting to devote resources more critically to bridges that are in more need of them, and bridges that are less in need to have perhaps a more extended time period.

Our problem is that the agency has provided no documentation, no study, no analysis whatsoever, of how, when, and where such cost effective gains would be made by having this kind of flexibility introduced. We basically have voiced the misgivings, the feeling that abuses will creep into the system very quickly, the same given by Commissioner Burns of Connecticut Department of Transportation.

If we see adequate research and investigation, a good analysis of what costs are involved, maybe then we could be persuaded that we might have some type of carefully controlled flexibility to be introduced. But generally, I would say right now, we have a cautionary attitude. Basically, it is the same as NTSB and the Connecticut Department of Transportation views.

Mr. CLINGER. You have also proposed to have a vast amount of regulatory activity not presently submitted to the Federal rulemaking process be submitted to that process. In essence, just about everything that could be done in this area would be subject to Federal rulemaking.

My own concern with that proposal is that, as you are aware, the rulemaking process is often a very long and tedious affair to go through. Isn't that going to impede our ability to move as rapidly as we should in the addressing of some of the bridge safety concerns?

Dr. DONALDSON. I am not convinced that is true, Mr. Clinger. I will give you an example why.

One of the comments that has been made repeatedly by the members who have been here today I think on a couple of occasions by yourself, in the late morning, was the need for us to institute much more vigorous stewardship. We want better Federal oversight in the bridge programs, yet we have a paradox on our hands.

First, we have a legal apparatus for the Federal highway program which is a grant in aid program, and essentially, when you have a grant program, you create a timid regulatory atmosphere.

Second, this committee, this Congress, has over the past 15 to 20 years increasingly asked the Federal Highway Administration to dispense with hands-on, out-in-the-field inspection, not to practice the kind of on-site oversight, but to look more at paper. That as the point behind the secondary road programs in the certification acceptance procedure in the late sixties and early seventies.

What I guess it boils down to is you can't have it both ways. If we want to have an informed professional public evaluate the standards that the agency adopts in order to guide this multi-billion dollar program, then I think that you have to realize it is just as necessary as all the other standards that this agency puts into rulemaking, and in each of those instances, Mr. Clinger, those standards and specifications for other program activities by the agency are in the Federal Register, and yes, they have long lead times for both NPRM, and final rules.

Sometimes it is years before we get a final rule. But ventilating those issues through the public participation process is the way that we prevent the kind of abuses that I think have occurred in the system because most of the policy making has just appeared as part of the regulatory apparatus of the agency, without the benefit of public notice and comment rulemaking.

Mr. CLINGER. I think that this morning, NTSB Chairman Burnett testified that unless we made changes in our present procedures and practices and make them relatively expeditious, we were running a real risk of having an increase in the number of disasters that occur.

Dr. DONALDSON. I would not want to delay expeditious treatment, but I would like that treatment to be specifically at the direction of this committee and this Congress.

We can have all sorts of emergency interim actions while much more well-paced and well-considered rulemaking can take care of more long-term needs in terms of the design, inspection apparatus, qualifications of inspectors, those elements in the bridge program.

Mr. CLINGER. You provided a very comprehensive list of things that you believe the Federal Government should be doing to improve—nine steps to improve the Bridge Inspection Program.

Most of those, I believe, would require an increase in both manpower and funding at both the Federal and State levels.

Have you costed this out in terms of what we might be looking at in terms of increased resources required?

Dr. DONALDSON. It certainly is going to take, for example, in the realm of maintenance performance standards, more rigorous maintenance inspection intervals, more frequent maintenance and certainly increase the burdens to the States.

We have only costed it out in the sense of a parallel program activity a few years ago, the resurfacing, restoration, and rehabilitation program. In that program we took the heavy maintenance burdens of the States and transferred them to the trust fund in order to satisfy these needs where light routine maintenance was left as a State responsibility.

Where the breaking point is now between heavy and light maintenance on bridges is somewhat uncertain. It is certainly different from the way it is done on highways, but I would think the Federal Government could look into some improved assistance to the States in areas where the States may be engaging in a heavy-duty type of maintenance burden on bridges which could be improved with Federal assistance.

Mr. CLINGER. You would agree with Mr. Roberts' testimony, you feel there should be additional funding?

Dr. DONALDSON. Yes, but I would not like the States to be taken off the hook for their day-to-day responsibility for routine maintenance. The kind of full-scale, anti-corrosion maintenance which most States are paying for themselves could conceivably come under Federal funding, but that remains to be evaluated.

Mr. CLINGER. Given the very rigid budgetary constraints that we are under these days both at the Federal and State levels, if it is not possible to fund all the changes that you would recommend, could you prioritize them?

Dr. DONALDSON. Absolutely, and I think that first and foremost is to make certain that we do improve Federal oversight and provide a comprehensive bridge management model for the States to emulate.

We need to have the Federal Highway Administration basically create a model of how to do efficient day-to-day management of bridges including maintenance, inspection, training, the priority selection of bridges for replacement and rehabilitation.

I think we can realize enormous economies if we get some of the States who right now are engaged in disastrously poor maintenance practices to tighten up, to have a bridge management system which is approved by the Federal Highway Administration for its adequacy.

Hopefully that will come about in the next year or two because we do have a study provision now which is looking after the necessity of having the States have bridge management programs.

That would be first and foremost.

Mr. CLINGER. Thank you.

Thank you very much, Mr. Chairman.

Mr. OBERSTAR. Thank you, Mr. Clinger.

We greatly appreciate your participation in the hearing.

Dr. Donaldson, Dr. Donaldson, excuse me, I am very concerned, as you are, and as you expressed so vigorously about the level of maintenance and quality of maintenance conducted on bridges.

I think that was touched on perhaps not as extensively, but certainly was referred to by previous witnesses.

How do you go about getting better maintenance? You have suggested some things, project selection methods and a list of other items.

I would like you to dwell on that a moment?

Dr. DONALDSON. I think the first thing you could respond to at a level which may be disarming because it is so simple, you could have written maintenance standards and criteria of whether to go, how and when you do routine maintenance on bridges.

There are States who literally work on a total ad hoc basis, relying completely on the personalities of key highway staff to go out and to find what needs to be done with a bridge.

It is basically a case of whether or not you have a stitch in time saves nine.

We have no written criteria, no model, no management systems. We don't even have historical data in many States on what they have done on maintenance.

They can't look up what a given State has done in terms of any maintenance practice on any given bridge in the State. It only exists in the personal inventory of the memory of a key highway personnel. That is number one.

Mr. OBERSTAR. You also suggest in your testimony that Congress should write maintenance standards. It occurs to me that the Federal Highway Administration has sufficient authority to do so by rulemaking which would be a lot quicker than to do it by legislation, if rulemaking isn't adequate we can always come back with legislation.

Is that a recommendation of yours that the Federal Highway Administration act more vigorously on maintenance standards?

Dr. DONALDSON. Absolutely. We don't want Congress to get into the business of trying to articulate specific standards.

We think Congress should direct the Federal Highway Administration, a charge which has been voiced by GAO reports over the past 10 years, that without clear maintenance standards and performance goals for the States in performing maintenance of the bridges and highway system as a whole, the States will be able to negotiate on a day-to-day basis with their division administrator what constitutes acceptable maintenance.

For years we have looked at the annual FY maintenance reports which have come in from the division administrators of FHWA and we have continually seen one division administrator after another saying, I am not going to find this state out of compliance with its section 116 responsibilities, but the maintenance of the roads are awful.

The pavement is broken up; the shoulders are unmaintained; we have pavement drop-offs; we have ponding of water; we have corroded deteriorated bridges and bridge decks; we have guardrails which have been damaged for months, and even years, that have not been restored and rehabilitated.

We need to have something more than an intent on the part of the division administrator to make the State conform to its section 116 responsibilities because they haven't done it as a whole over the years.

Mr. **Oberstar**. Do you have from your work on bridge issues sort of a check list of maintenance items, standards that you would recommend to be incorporated by the States in their programs?

Dr. **Donaldson**. In a sense, yes. The unfortunate fact is that such a check list is now distributed through at least four or five major documents.

One of them, one that you may not be aware of, Mr. Chairman, is internal FHWA-produced maintenance guidelines for people in the field to use when they go out to assess the adequacy of the State's 116 compliance with their maintenance responsibilities. That guidance for field personnel from the Federal Highway Administration has an ample portion in it on bridges.

We have the checklist which is in the maintenance manual of bridges which has been issued by AASHTO for years and is made a Federal requirement. We like some of the guidelines in there, are not happy about others, but since it has never been put through rulemaking, we and other members of the public who might have something to say have no way to say that.

There are also guidelines on maintenance features to be taken into consideration in the standard specifications for highway bridges. Even in the bridge inspectors training manual there are sets of checklists in there on what to look for in terms of adequate maintenance of a bridge. So we have four major documents where we need to have it all drawn together in good rational unification of what we should go after in terms of maintenance.

Mr. **Oberstar**. Thank you.

We will raise those matters with the Federal Highway Administration tomorrow.

On page 20 of your statement you ask, perhaps a bit rhetorically, whether the subcommittee knows that the Federal Highway Administration required each state to have a well-founded underwater inspection program, you refer to a June 25, 1985 memorandum. We do have that memorandum——

Dr. Donaldson. We would love to have a copy, Mr. Chairman.

Mr. Oberstar. We will make a copy for you.

It does not use the word "require." The language is, paragraph 5, 6—each State as part of its bridge inspection program procedure should have, and lists four items. It doesn't say it must have.

Dr. Donaldson. Yes; and the reason we used the word "required" was that we had gotten a hold of a compendium produced by the Federal Highway Administration of memoranda sent to the field over the past couple of years, and the item that tipped us off was the fact that there was an underwater inspection program, and the word used was "required" for the States to have one, so there is obviously a discrepancy in FHWA office between thought and reality.

Mr. Oberstar. The word "required" is missing. It says the AASHTO manual specifies that five years is the maximum time interval between underwater inspections, yet we find that the AASHTO manual refers to the interval as normally should be required at approximately five-year intervals except under unusual conditions.

Dr. Donaldson. Correct.

Mr. Oberstar. How was the five-year cycle for underwater inspections arrived at, simply arbitrarilly, as suggested by a previous witness, was there some thought process that went into that selection of a time frame?

Is there research that supports five years or a lesser period of time.

Dr. Donaldson. I think the first part of your question was there some thought, yes. There wasn't research.

I think we have something here which is not as sophisticated as it may look. We should gauge the quality of the response by the AASHTO representative that was given here.

I think basically the five-year interval was a consensus reached by the majority of the states' who participated in the work of the AASHTO Bridge committee, that five-years is a not too excessive period of time with which the states with their manpower and resources could accommodate. I don't think it has any rational foundation whatever in terms of bridge needs but only what could accommodate the states' desire to have a certain level of intensity of underwater inspections and no more.

The AASHTO representative today from the State of California does not regularly observe a five-year inspection interval itself, in fact, it usually operates on a six-year inspection interval and it has argued with its division administrator over the past two or three years over insisting that it adhere to a six-year inspection cycle.

I think when one wonders about the intent of a State in wanting to vigorously pursue underwater inspection, I think it is being done on the basis of manpower and resources, not on the basis of bridge needs.

Mr. Oberstar. In this matter of environmental effects on bridges and inspection standards, should there be different standards for different conditions?

Dr. Donaldson. Yes.

Mr. **Oberstar**. That is brackish water, salt water, areas where there is fast running water have different conditions as compared to those where the bridge support structure is in still waters, where there may be only mild currents in the waters as opposed to fast moving currents.

Dr. **Donaldson**. Yes, that would be a very reasonable approach. The only problem is that as we have heard in testimony today we have defective designs which have been basically underwritten by the Federal Highway Administration and AASHTO's own bridge design specifications having been built in years past.

The Schoharie Bridge is an example of that. In a 1948 edition of the AASHTO inspections we had strong hortatory language in there that you should not ever have spread footings in even highly compacted glacial till without having pilings driven under it. That section does not exist in the 1983 AASHTO edition of the same specifications. So I wondered whether, in fact, countering what Mr. Roberts said, if we are moving forward, we may be in many instances moving backwards in the character of our design specs.

This and other considerations about turbidity of water, scour and things like that also hinges on the quality of materials being used. We have had testimony today that we have used steel in many of these bridges, which is highly subject to severe fracturing, perhaps causing catastrophic collapses in a very short time.

I guess my reservations are, yes, it sounds good on the surface that we should have a rationally apportioned intensity of effort for bridges in fresh standing water as opposed to, say, vigorous tidal flow in estuaries, which have the ability to induce corrosion very rapidly. But that also depends on the design of the bridge, its inherent strength, and the materials used. And one wonders how well the states as a whole are going to be able to assess all those variables and control them adequately so we get the kind of standards that will really permit the use of that kind of rational flexibility in the intensity of effort in underwater inspection.

We don't seem to have it now, and I don't see it coming around the corner in the near future.

Mr. **Oberstar**. I recognize and accept what you are saying about designing a bridge and applicability of design to location, but since statistics show that flooding is the most frequent cause of bridge collapses, it seems to me more careful attention ought to be paid to inspection of bridge construction in flood-prone areas.

Dr. **Donaldson**. Yes. High water velocities certainly are very important.

I hope that we will not forget, though, that we have had significant bridge collapses in this country due to navigational problems with large ocean going vessels. The Sunshine Skyway Bridge in Florida is a good example of that.

We can't forget that sometimes other agencies come into play to bring a bridge down other than its own inherent deficiencies. But, yes, we agree in principle.

Mr. **Oberstar**. Page 6 of your testimony referred to State inspections conducted with unqualified inspectors, inadequate equipment and techniques. How did you come to that information and on what is it based?

Dr. **Donaldson**. It is not hard. We could name states but that is not necessary.

It comes from the Federal Highway Administration's own assessments either through their annual maintenance reviews or through the special NBIS reviews they held a couple of years ago, of not an inconsiderable number of States in which the States were using unqualified or underqualified bridge inspectors.

I would instance, for example, the non-engineer who inspected the Schoharie Creek, standing on the creek side and proclaiming that because he did not know what the condition of the scour was around the footings and couldn't see, he coded it 9.

Unfortunately that is just one example among hundreds that occur every year where we have unqualified or underqualified inspectors among many states performing completely incompetent inspections. I did instance a few in my testimony about interim inspections.

Even in those instances in states where the regular two year cycle or thereabouts is being observed properly with good inspectors and good documentation if a bridge is very often found to be deficient those interim inspections are often much poorer than the ones on the regular two year cycle and I don't think any attention has been given that today.

A lot of those interim inspections by a lot of states who may otherwise be responsible about the regular two-year cycle inspections are going down the tubes along with no documentation as well. It is mainly look-sees and walkovers.

Mr. **Oberstar**. You referred to that and that fits in with questions raised by the Safety Board's testimony today regarding the adequacy of training of inspectors. It is one thing to conduct frequent detailed inspections, and another to have that done by qualified personnel, people who will recognize a problem when they see it.

Since you refer to unqualified inspectors, what are your findings about the qualifications of inspection personnel?

Dr. **Donaldson**. Well, three major points I could make about that. One, starting below the surface of the water and moving up into the open air, I don't think there is any question that there are hundreds and hundreds of divers in this country among those states who are even attempting to use diving underwater inspections to check the support integrity of bridges that are under-or unqualified for the job.

We had a comment here today that the best maintenance tool or techniques you could use is your eyes. We had that from the AASHTO representative, and I agree.

The only problem is that in above-water inspections we very often have a well qualified inspector, even professional engineer whose eyes are telling him an awful lot, well-trained eyes, but that same State, in many instances, will use a diver who doesn't have those well-trained professional eyes, dealing with members of that bridge, which are arguably much more catastrophically important to the integrity of that bridge, and they are there on a low bidder basis.

They are not engineers. They have only the little bits and pieces of knowledge built up by making dives before. They may have made a bid eight years ago and didn't get the contract, and now they are back and what have they done in the interim to refresh their memory?

Mr. OBERSTAR. We also heard that for a relatively modest cost of $1,000 or $2,000, you could train that diver to look for particular problem areas and to recognize defects.

Dr. DONALDSON. That is right. In fact, I think right now our maintenance manual for the bridge inspection has addressed its prerequisites for good training overwhelmingly to the above-water inspector, the man walking on the bridge deck, the man in the snooper looking at the underside of the deck.

But it has let the responsibility for what we should have as the more intense and peculiar training responsibilities for divers fall through a big crack, and we have to cure that problem.

Mr. OBERSTAR. Should such a training requirement be included in the proposed rule making of the Federal Highway Administration?

Dr. DONALDSON. Not only that, but if we have a training manual for inspectors which sets forth the qualifications and guidelines for what inspectors are supposed to know and do, let's put it in for rule making so that we, the National Transportation Safety Board, and other well-informed individuals can comment on what we think we need to have as improved underwater inspection qualifications.

Mr. OBERSTAR. This is an area that particularly concerns me as we see these problems with bridges in flood conditions, with swirling waters, and powerful forces that have devastating effects—that is when you really need to have the most qualified kind of inspections, of those areas that you can't walk around, look at, or use an arcticulated armed crane. I agree.

Dr. DONALDSON. I want to make one comment about the section of my testimony dealing with policy making without the benefit of public participation. I think that the genesis of the proposal that we have in the Federal Register, which has come in for some harsh criticism today, ought to be pointed out—where did this rule making proposal come from?

We know that in 1983 the Federal Highway Administration came up with a proposal for flexibility and as you pointed out, isn't it a wonder that at one time we had a statement that we are not going ahead with this because we now realize we have gotten the true religion, that safety is going to be compromised.

How could we have been such fools to think that flexibility would have given us the kind of benefits we want, we got to keep things on a tight schedule, that will give us the safety benefits we want and then three years later we have the same proposal albeit with extra thrown in on underwater inspections and fracture-critical members. Why did the Federal Highway Administration come back three years later? For two reasons.

Number one, the fires of iniquity had come and gone, their feet had not been burned as badly as they had been before and looked as foolish as they did in 1983 and 1984.

They thought that things had calmed down—low and behold a bridge falls down while the thing is being shunted over to the Federal Register. And two, this was already a fait accompli: In 1984

AASHTO added language to their maintenance manual for the inspection of bridges that said two-year cycle except under those circumstances where you can legitimately realize a more extended period of time governing the inspection of this bridge.

FHWA repeatedly on many program fronts, will have something that will pass muster at AASHTO and then will be intimidated to capitulate to the AASHTO fait accompli. AASHTO has decided on this in 1984; what FHWA basically is doing is using the notice of proposed rule making to ratify what ASSHTO has already agreed that its member States are going to do.

This is really the cart before the horse. We need to have a Federal Highway Administration presence in the bridge program which is much stronger and has more integrity than this.

We don't need a Federal Highway Administrator who genuflects to the States' interest group's policy of changes and technical specifications. That amounts to in the end the regulated writing its own regulations and then the Federal agency bringing up the rear and simply putting the imprimatur of legitimacy on it by moving it through the Federal Register, in which case we have the comments of all the states come in and then we have the popularity poll.

We have been in that popularity poll debate for many years now, where we and a few other individuals will say no, this is a bad idea, but we have 50 States over their saying yes, it is a great idea, and who do you think wins in the end? In every instance we have a division in the ranks, the 80-20 split, with us always in the minority.

We have to have a Federal Register presence where the steward of this program is willing to take the bull by the horns to exercise its own statutory responsibility towards bridge safety. And in the end, to speak strongly, Mr. Chairman, we have to have a Congress who will tell them to do more than just have the NBIS for bridge program regulation.

We need a Congress that will tell them to do more with maintenance, more with maintenance standards, the kinds of direction that this agency needs, because on its own terms, it will not take any of these necessary actions.

Mr. **Oberstar**. The purpose of the hearings is to get to that point, to find out what are the pressure points, what needs to be done, and to urge the proper action and these steps to be taken.

Design standards was an issue referred to most pointedly in the Connecticut testimony but there was sort of an internal contradiction. Connecticut referred to the engineer who did an analysis of the Mianus Bridge and said that given the design, collapse was inevitable, and then said inspection, however, was not a factor, lack of adequate inspection was not a factor in the collapse of that bridge.

I find that contradictory, because if you had had good inspection it should have picked up the fact of the inadequate bridge design and the problems and pointed them out so they could be corrected. If you have a bad design or bad construction, good inspection would pick that up, it would seem to me.

Dr. **Donaldson**. And bad maintenance practices subsequent to the construction of that bridge. That was a very important piece of testimony provided by Commissioner Burns, first of all—to be honest about it, Mr. Chairman, a lot of what you have there is tort posturing.

This state is going to get stuck with a lot of suits and if it can blame it on design it has design immunity. If it blames it on discretionary actions it will be in the courtroom losing a bundle. We have all seen the record on the Mianus Bridge.

We know drainage grates in the bridge had been paved over years before, so we had salts oozing through the deck and ruining the reinforcing bar. We know the design of the bridge is basically defective and in some generally principled ways, the same way as the Schoharie Creek Bridge, neither was a redundant structure.

The Schoharie Creek Bridge was simply a set of independent spans which were linked end to end sitting on independent rocker bearings.

On the Mianus Bridge we had the nonredundant pin and hanger design. Both of those designs you will not see in France and England and Germany and will not have seen them for the past 50 years because they are illegal.

Mr. OBERSTAR. Do you feel that current Federal design standards, if followed by states in bridge construction, will eliminate the possibility of a bad bridge construction?

Dr. DONALDSON. No, for two reasons. One, because if you actually read—a lot of people talk about the AASHTO standard specifications for bridges.

If you actually read it, you are going to find very little specification is in their hard numbers. You will find an enormous amount of hortatory language.

Mr. Roberts, from AASHTO in talking about the manual for maintenance inspection of bridges, mentioned how we had this new specification in there. What was the topic on that—in fact, when you read that specification language it is totally hortatory from beginning to end.

If AASHTO doesn't have good enough lawyers to tell them the difference between standard and hortatory languages they ought to get one, because most of the stuff you see in these mentioned that AASHTO calls standards and specifications, in fact, are things like when the state, under certain compelling circumstances, has this and that situation, it should make every effort to be able to look at such and such. That is not a standard, that is not a specification. That is hortatory guidance to people in the field. And you will increasingly see design standards put out by AASHTO written that way, because they don't want lots of hard number threshold in the standards because that makes it harder to get out from under when you build a bad bridge and it fails and you are in the courtroom.

We see that in many other areas in both FHWA and AASHTO voluntary standards-making where we soft peddle the "shalls" and hard numbers and get the hortatory language, the "shoulds" and the "mays" and "it should be considered," and so forth, that we had today in Mr. Roberts' testimony.

Mr. OBERSTAR. I think we need to pursue the matter of design standards, because if the design that you start with is faulty, then no amount of good construction that follows upon that design is going to discover the fault and correct it, unless you get someone exceptionally sharp to build it for you. Not many contractors like to do that. They are going to follow the design standard.

Dr. **Donaldson**. As I indicated, you have the example of the Schoharie Creek bridge where you have a previous AASHTO standard which spoke out very strongly against the very design practice that was used in that bridge, which was erected only a few years later after that edition, and yet that same parallel passage no longer exists in the current full edition of AASHTO standards.

That is a very revealing exercise, by the way, Mr. Chairman. The FHWA very often likes to go through exercises with the AASHTO bridge specifications, where they will take all the numbered passages, sections of the bridge manual and put them in a tabular form side by side—1984 edition, 1983 edition—and you will see a hole here and something here. You will go down the next level and see something here. There is constant patchwork quilt work being done on the bridge specifications. There are a lot of musical chairs in there.

Not all the motives are just to build the best bridge that you can get, and if you are going to try to dampen the enthusiasm for people manipulating standards, which are trying to give them protection to insulate them against, for example, adverse tort judgments, not just to build the best bridges, then, as I made the point earlier, we are going to bring out that document and have it ventilated for rulemaking, have everyone who is an informed member of the public, be able to have their say in the rulemaking notice.

Mr. **Oberstar**. Your testimony also refers to the very large role of local government inspection. So many of these bridges are locally owned, there should be tougher requirements on those local governments for more than just walk-around inspections and penalties should be imposed.

First, it occurs to me that the Federal Highway Administration has adequate authority in current law to do so if they choose.

Dr. **Donaldson**. In the past couple of years up to 150 local jurisdictions have received temporary sanctioning for failure to comply with the NBIS.

Mr. **Oberstar**. There are further steps the Center thinks should be taken in that respect?

Dr. **Donaldson**. Yes sir, because you cannot have a Federal steward with the manpower and resources having a hard enough time dealing with 52 major jurisdictions, and also ask it to move down beyond the State level to jawbone and pick on thousands and thousands of local jurisdictions, which in many instances, the State government literally is legally incapable of telling the county and the city to abide by the NBIS to do good maintenance, to use good management practices. It can't tell it a thing, yet, of course, only the state is responsible in terms of its compliance requirements.

Mr. **Oberstar**. In fact, those local jurisdictions are not independent entities, they are accountable to an agency of the State?

Dr. **Donaldson**. Unfortunately, in some States, the constitution of the State literally prohibits the state government from certain kinds of incursions into the discretionary power of the States and counties. We ran into that years ago with other programs, particularly in the Midwest, which is—as you may be familiar with, being from Minnesota—there was an extremely powerful tradition of independent autonomous county highway departments, particularly in States like Indiana, Iowa, Nebraska, and all the rest, which later came under the umbrella of the State highway department or department of transportation, and I want to tell you there was kicking and screaming the whole time for decades in trying to eliminate the powers of some of these counties, and they asked for constitutional protection against State powers. In many instances they got them.

So it is not easy business. The State can't come into some counties and cities and do anything. To tell them to post load their bridges, if the county refuses to do it, there is nothing they can do. We have anecdotes we have supplied to your staff of States. I have talked to some States who are very responsible where they have literally been wringing their hands in desperation over trying to get some of the counties and cities to do something. They have made phone calls, sent registered letters to the counties saying you must post this bridge, you must load rate, and they don't get any return to the phone calls, don't get any response to letters, and those bridges continue to go unposted.

Those are problems the States are up against. I don't think those are going to go away. I don't think the Federal steward can cure the problems. I don't think the States can ever bring all these counties and cities to brook—certainly not some of the cities I am familiar with.

Mr. **Oberstar**. I thank you for that insight. That is a very important factor to keep in mind in considering this massive issue of bridge inspection.

Finally, on the matter of technology. Technology isn't always the answer, I think it takes hands on experience, certainly our hearings in other areas—aviation and pipeline safety, show again and again that paper audits are important, but hands on inspection is more important, and more effective. So also is technology. It can be a very great help in doing thorough inspections.

Are you satisfied that available technology is being widely applied by States in their bridge inspection efforts? Is there technology that is available that is not being used?

Dr. **Donaldson**. Well, the answer to both of those questions is not amazing. For us it is obviously no. There are many States out there who are not even using the easily available technology. I can think of one mid-southern State right now, who just last year had their first snooper. They have never had a snooper to look under the bridge before.

In terms of more sophisticated technology, many of the States basically are only dimly aware of what that technology is. The big thing on the horizon right now, is NDE. I was one of two highway representatives on a recent National Research Council panel which was attempting to establish an infra-structural research agenda for the 21st Century and the most interesting thing about that was that outside of the main panel report, which was ultimately a report to Congress, who had created this study, was an entirely separate appendix to the study just on nondestructive evaluations.

There are the States right now who are having severe problems with their bridge programs, with doing ordinary day to day good inspection. They are so far back in the hole on good inspection techniques, getting good management decisions brought into play, getting good documentation on their bridge programs, they are not even thinking about sophisticated technology. They are lucky if they can afford to do good maintenance and inspection—one or two or three snoopers to go around and do the kind of work that for years they stood 500 or 1000 feet away and on a creek bank and looked up under the deck to try to make a guess as to what the condition of that bridge was.

So, for some States, we are years away from having sophisticated technology. Other States, like California and perhaps New York and a couple others, they will try to stay on the leading edge of developments in NDE and other sophisticated technology. But it is too much to hope for that in say the next five years, that the overwhelming majority of the States will be using sophisticated technology.

Mr. **Oberstar**. A very sobering assessment.

I appreciate very greatly the time and effort that you have taken to present the committee with your views on this very, very important issue and for the continuing work of the Center on the bridge issue. Please continue your efforts, and again, thank you for being with us today.

Dr. **Donaldson**. Thank you Mr. Chairman. We appreciate that.

[Dr. Donaldson's prepared statement follows:]

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TESTIMONY OF GERALD A. DONALDSON, PH.D.
HIGHWAY SAFETY DIRECTOR

BEFORE THE

SUBCOMMITTEE ON INVESTIGATIONS & OVERSIGHT
COMMITTEE ON PUBLIC WORKS & TRANSPORTATION

ON

BRIDGE SAFETY AND INSPECTION

DECEMBER 1-2. 1987

The Center for Auto Safety is a consumer group founded by Ralph Nader and Consumers Union in 1970 but which is now independent of its founders.

CENTER FOR AUTO SAFETY TESTIMONY
HOUSE PUBLIC WORKS COMMITTEE
DECEMBER 1-2, 1987

[Mr. Chairman, our national bridge program is in serious trouble. The safety of millions of Americans has been jeopardized by inept Federal stewardship over our bridge inspection and rebuilding effort. The states have misspent millions of scarce Federal-aid bridge dollars through dereliction of their responsibilities to the travelling public.

This sad, and sometimes tragic, story is not one that can be told only by neatly summed columns of numbers showing compliance with the National Bridge Inspection Standards (NBIS) or by lists of obligational figures representing the states' use of Highway Bridge Replacement and Rehabilitation Program (HBRRP) funds. The failure of America's bridge program is a story of irresponsible state, county, and city management of nearly 600,000 bridges; of deferential FHWA Division Administrators whose bridge program philosophy has been "go along, get along"; of national policy choices made behind closed doors without public rulemaking; and of state control of inventory, inspection, posting-and-closing, maintenance, and bridge replacement project selection that has demonstrated a chronic, pervasive pattern of neglect and waste. In the following pages, Mr. Chairman, I will survey the basic defects of our national bridge program and set out what we think needs to be done by this Congress, the Federal Highway Administration, and the states to put this program back on track.]

- MAINTENANCE

Yes, Mr. Chairman. The first topic to be considered is maintenance, not NBIS compliance figures, not inspector qualifications, not HBRRP obligations, not even the feeble regulatory machinery of the FHWA. [One of the most fundamental defects of our bridge program is the persistent failure of the states to perform reliable, cost-effective maintenance of our nation's bridges in compliance with Federal statutory responsibilities. Without rational maintenance management, without the efficient use of state and local funds to keep bridges in sound condition through timely application of intelligent maintenance strategies, HBRRP funds are called into play too soon and too extensively.] As one New York State DOT official recently said:

> Bridge maintenance is in the Stone Age. We have no good, logical way of selecting the proper bridges to repair, rehabilitate or replace other than our memory and manual review. . .
> At the present time, our bridge histories are sketchy and haphazard at best. There is no cohesive attempt to gather the information on work done by Bridge Maintenance forces or contract work into one location [and] [t]he type of work accomplished is never shown.

These comments can apply to almost any state, Mr. Chairman. [Most states have virtually no bridge maintenance programs with specific, quantified maintenance goals; no documented maintenance processes; no rationally planned aggressive strategies to arrest or slow bridge deterioration. Many states address maintenance deficiencies on an *ad hoc* basis and rely only on personal familiarity by certain highway staff with bridge maintenance problems. As a result, thousands of bridges at the state, county, and city levels are left in chronic derelict condition with unchecked corrosion, deteriorated decks in desperate need of routine periodic overlays, and unrepaired or obsolete bridge railings with poor crashworthiness. Further, once maintenance is performed, no follow-up systems of evaluation of effectiveness exists in most states; no method of comparing one maintenance strategy against another; and, oftentimes, no records whatever are kept even itemizing what kind of maintenance was performed on a given bridge. The states, and thus FHWA, especially at the Division level, have no information from which to calculate the effectiveness of various maintenance techniques nor to judge the comparative cost-effectiveness of differing maintenance processes, materials, and intervals. Consequently, the next question of whether Federal HBRRP funds are being used wisely and applied judiciously in the right priority ranking to deficient bridges cannot be answered except by guesswork, intuition, and subjective "engineering judgment." How can we expect any state, Mr. Chairman, to have an efficient, comprehensive NBIS effort and rational HBRRP project selection methods when this same state flies its bridge management effort by the seat of its pants?

And where is the Federal effort here, Mr. Chairman, the effort to advance the states' compliance with their 23 U.S.C. § 116 responsibilities, to deploy efficient, cost-effective maintenance programs that make the best use of state dollars so that the states can make the best use of Federal dollars? Where is the comprehensive Federal bridge management model for the states to emulate? Where are the specific maintenance performance goals spelled out in FHWA regulations to be used as measures of adequacy by FHWA field personnel in judging the states' statutory maintenance compliance?

There aren't any. The states don't want them, so the FHWA doesn't dare propose them. This was recognized by the General Accounting Office six-and-a-half years ago:

> FHWA has misinterpreted its responsibilities for requiring timely preventive maintenance. It has interpreted the law as authorizing sanctions only when highways became unsafe or unserviceable rather than for failure to perform routine preventive maintenance on a continuous basis.

Deteriorating Highways and Lagging Revenues: A Need to Reassess the the Federal Highway Program, CED-81-42, March 5, 1981, at 49.

Mr. Chairman, unless Congress directs the institution of Federally-approved bridge maintenance procedures and performance goals as integral components of a comprehensive bridge management program, the states will continue to make hip-pocket judgments on maintenance. Unless Congress specifically mandates the institution of cost-effective maintenance standards for state observance, what counts as acceptable maintenance in any state is what can be negotiated with its Division Administrator.

What kind of response can we anticipate to any Federal move to require comprehensive bridge management systems throughout the states, much less the imposition of maintenance standards? One good indicator is the recent FHWA survey conducted as the initial step in FHWA's study on bridge management systems pursuant to the Surface Transportation and Relocation Assistance Act of 1987. The FHWA survey showed a pervasive lack throughout the states of any documented, formal management methods or criteria for performing routine bridge management tasks. These tasks include:

- Estimating current needs
- Priority ranking for rehabilitation and replacement
- Other priority ranking systems, excluding maintenance
- Rehabilitation vs replacement
- Recording of maintenance needs
- Maintenance prioritization
- Maintenance monitoring
- Needs projections beyond 5 years
- Overall program evaluation
- Distribution of off-system HBRRP funds

Not a single state answered in the affirmative for all areas and most states lacked one or more -- usually several -- of the areas. Amazingly enough, Mr. Chairman, a few states even checked "NO" for every area.

Against this unhappy backdrop of responses, the FHWA then asked for each state to indicate its intensity of interest in having a comprehensive bridge management system. The categories started with "Committed," descending through "Strongly Motivated," to "Interested," and bottoming out with "No Expressed Interest." The states as a whole, Mr. Chairman, overwhelmingly responded that they were only "Interested." Only very few claimed "Strongly Motivated," and virtually none asserted that they were "Committed." A few states answered that they had "No Expressed Interest"! And among these uninterested or only mildly interested states -- the great majority of responses, mind you -- are many of the poorest records of bridge maintenance, NBIS compliance, underwater inspection, and cost-effective use of HBRRP funds.

• NATIONAL BRIDGE INSPECTION STANDARDS

The first thing that must be said here, Mr. Chairman, is that the trap of the NBIS to be wary of is playing the numbers game. Tomorrow the FHWA will come before this Subcommittee with neat lists of numbers showing incremental improvement each year in compliance by the states with the inventory, 2-year inspection cycle, and load rating/posting-and-closing requirements of 23 CFR Part 650. These numbers are not reliable indicia of the quality of regulatory compliance even in many of those states where there has been significant improvement since 1983-84 when FHWA was motivated to do something affirmative in the wake of the Mianus Bridge collapse and the Center's court action against the agency. Many states are right now performing shoddy inspections with underqualified inspectors and inadequate equipment and techniques. These abuses accelerate when one moves to the local jurisdictional level. Many counties and cities are right now, for the very first time, inspecting thousands of structures that have never been inspected in living memory. Local officials continually soft-pedal the quality of these inspections, particularly when inspection requires a bridge to be coded as deficient thereby requiring interim inspections between the two-year cycle.

And however poor and cursory regular 2-year inspections are performed on many state, county, and city bridges, these interim inspections are even more casual. Often, especially at the county and city levels, these are nothing more than "walkovers" -- no dives for underwater inspection when the structures are in deep water, no snoopers, no testing equipment, just a quick look-see. In some states, these interim inspections are not even being performed at any jurisdictional level. And when they are performed, however poorly, there often is no documentation of any kind, no records for future use.

Equally often, these deficient bridges require the posting of loads lower than legally permitted state maximums. Thousands of bridges are just now being posted that should have been posted years ago. Local jurisdictions especially dislike posting. Posting requires longer circumventing routes. Posting requires costly installation and maintenance of the signs. Posting means a deficient bridge that requires interim inspections. It is no wonder that many hundreds of newly posted bridges have their signs repeatedly disappear. To post a bridge for lower loads means inconvenience, economic losses, increased governmental burdens.

The most recent Bridge Inspection Status Report from the FHWA that we have been able to secure shows half of the states still in non-compliance or "partially" in compliance with posting and closing requirements. In fact, as of mid-1986, more than 36,000 bridges should have been posted, but had not been. This is almost 3,000 more than in 1985. No doubt FHWA will be able to one-up us tomorrow with later and superior numbers. But the important thing to stress here is that, in the majority of instances, the problem lies preponderantly at the local level. Many states claim that they have little authority over city and county NBIS compliance, including posting, and can only jawbone local officials into obeying the law. This is an enervating task for any state, Mr. Chairman, to constantly have to cajole, exhort, vaguely threaten, or otherwise coerce its counties, cities, and townships into obeying the law. If we seriously intend to give notice to the travelling public that load restrictions are in effect on thousands of our local bridges, if we want much better NBIS compliance and improved local government use of scarce HBRRP funds, then Congress must consider whether the time has come to address Federal statutory requirements in the bridge program directly to cities and counties because we do not believe that the states as a whole can ever bring them to brook.

With regard to 2-year inspection cycle compliance, who knows what numbers are believable, Mr. Chairman? It is impossible to get an accurate picture of compliance because FHWA at its headquarters offices uses a 3-year threshold for reporting compliance. We have heard in the past some of the rationalizations offered for allowing another 50% to be added to the regulatory timeframe of two years (late data bank entries and the like), but perhaps there are novel ones we have not yet heard. In any case, the compliance numbers are bad enough on a three year cutoff; one can only wonder over what a real 2-year listing would look like.

So is inspection compliance any better now than, say, three years ago? Maybe in some states, but obviously not in others where intermittent memoranda from the Division Administrators of several states to their Regions, or evaluation commentary resulting from the recent nationwide FHWA special NBIS reviews show Federal officials wringing their hands in despair or exasperation over not only lackadaisical compliance efforts, but over defiantly intransigent state attitudes towards inspection compliance.

Except for a very few dissenting voices, the states are now crying out against the tepid efforts of the FHWA to enforce the 2-year inspection cycle. In many states, the 2-year cycle was always honored only in the breach. The states as a whole in fact had a flexible inspection schedule due to lax Federal enforcement.

Now the states claim burden when, for the first time, the

Federal government makes an effort to secure compliance and, as a consequence, they demand flexible inspection schedules that will exceed, even double, the 2-year cycle now in effect. But one must ask, Mr. Chairman, how good is our national bridge program right now from all those years when the states could flout the 2-year cycle with impunity? Now we are told that legalizing this flexibility through an amended bridge regulation will ensure the cost-effective use of Federal and state bridge dollars. How cost-effective were the uses of these dollars in states that had never even made an effort to conform to a 2-year inspection cycle since the inception of the NBIS sixteen and one-half years ago? In many cases, these states' bridge programs were a shambles. And we are now asked to believe that Federally-permitted flexibility will bring in the millennium, will reap tremendous benefits that *ad hoc* flexibility did not produce in the past?] There is much here to be cynical about, Mr. Chairman, and much to suspect about the states' motives. I will return to this topic later in my testimony.

◦ THE FHWA NBIS PROPOSED RULE: UNDERWATER INSPECTION

Mr. Chairman, at a time when the FHWA should have seized the initiative and issued strong, specific regulations aimed at radical improvements by the states of the underwater inspections of thousands of bridges over water, FHWA has instead proposed the ineffectual *status quo* of the 5-year inspection interval recommended by

AASHTO and not espoused by FHWA as a requirement until the current proposed rule was issued this past Spring. Some states even openly ignored the AASHTO recommendation with underwater inspection intervals of six, eight, and even ten years. And oftentimes these state-generated guidelines meant little in practice. Further, there are states which prior to the FHWA renewed management effort had never performed a single underwater inspection on any of their bridges. One state has just conducted their first-ever underwater inspections this past May of 1987.

This incredible -- and frightening -- story of massive dereliction by the states of the obvious responsibility to determine the integrity of in-water bridge supports came to a head only a year ago in the National Transportation Safety Board's (NTSB) report on the causes of the collapse of the Alabama Chickasawbogue bridge. In that report, the Board strongly criticized the failure of the states to perform adequate, timely inspections of the nation's bridges. And in the Conclusions section, NTSB stated that:

> The FHWA . . .do[es] not provide any effective criteria to assist the States in determining the type, depth, and frequency for inspection in developing a program to inspect the underwater elements of bridges.

And,

> The 5-year cycle for inspecting the underwater elements of bridges which is suggested in the 1983 AASHTO Manual for the Maintenance Inspection of Bridges, is not supported by research or engineering analyses.

Consequently, the Board specifically recommended to the FHWA that it should:

> Establish criteria for inspecting the underwater elements of bridges which consider the following factors as they relate to bridge design and maintenance:
> Complexity of structure and materials used,
> Marine environment surrounding the underwater elements of the bridges, and
> Frequency and magnitude of loads on the bridge.

The current rulemaking proposal of FHWA contains none of these badly needed criteria for the states to observe when inspecting the underwater features of bridges. It is obvious that in this proposal, Mr. Chairman, FHWA has ignored or contemptuously dismissed the Board's sound recommendations. Despite the fact that thousands of bridges have had completely inadequate inspections of underwater integrity consisting only of above-waterline visual inspection or desultory probing and conducted oftentimes by poorly trained inspectors, FHWA has seen fit to provide no regulatory requirements on what methods must be used to perform adequate underwater inspections.

Furthermore, the agency does nothing to ensure that only highly qualified, well-trained personnel perform underwater inspections. Many states use inexperienced divers with only limited, piecemeal engineering knowledge. These divers frequently are engaged by the states through low-bidder contract. But, optimally, Mr. Chairman, only divers with professional, intensive engineering training should be used for underwater inspection. A diver without professional knowledge cannot successfully act as an engineer's surrogate. Given the clarity of need for a rapid improvement in

Federal guidance for underwater inspection through new regulations, FHWA has defaulted on its Federal stewardship responsibilities to ensure the safety of the American motorists who traverse bridges over water.

Let's not forget that this impotent rulemaking proposal was issued only two days after the tragic catastrophic collapse of the New York State Thruway bridge over Schoharie Creek, a bridge collapse brought about directly as a result of incompetent, negligent underwater bridge inspection, underwater inspection performed by a non-engineer who did a creek bank "look-see" and who coded the scour condition of this enormous bridge's footings as "9" -- which means "don't know and can't find out."

- THE FHWA NBIS PROPOSED RULE: TWO-YEAR INSPECTION CYCLE

These considerations on underwater inspection lead us directly to the other major topic of the FHWA's rulemaking proposal. Purported cost efficiencies comprise the main argument of the FHWA in its desire to relax the current 2-year cycle of bridge inspection and to install in its place a flexible schedule to be determined uniquely for each candidate bridge or group of bridges. Yet nowhere in the Notice of Proposed Rulemaking (NPRM) is there a citation to any studies made or used by the agency to demonstrate that a flexible schedule of inspection will secure substantial savings of HBRRP dollars currently spent on inspections and no evaluations of such prospective savings are attached by the FHWA to the public file for the docket. But given the increasing loss of lives over the past few years through catastrophic bridge collapses, we don't see how anyone can accept that a weakened system of inspection can redound to the economic health of the nation's bridge replacement and rehabilitation effort.

Let's all face reality, Mr. Chairman. If the states are allowed flexible bridge inspection schedules, many states will not establish schedules based on reliable estimates of cost-effective inspection cycles that also guarantee optimal safety. These states' primary motive will not be to optimize inspection intervals on the basis of bridge needs, but to accommodate the intensity of bridge management effort which which they feel comfortable.

Furthermore, the FHWA assumes as a given that less inspection is inherently a cost-saving approach which will inexorably translate into increased expenditures for bridge renovation and replacement. This is not only simple-simon logic, Mr. Chairman, it also assumes as an axiom what the agency must prove and has not to date. And the contrary condition is abundantly exhibited in those states in which rigorous inspection on a rapid cycle has fostered early detection of deteriorated bridge components, a practice that these states can show have generated tremendous savings of Federal dollars in the long run. In fact, Mr. Chairman, there are a very few states -- one of them is Minnesota -- that inspects all of their bridges on an annual cycle. FHWA's pronouncement that Federal funds purportedly "saved" by relaxing the two-year inspection cycle will facilitate more bridge replacement and rehabilitation is unsupported in the rulemaking record, is founded on an unverified premise, fails to consider the enhanced safety and cost-effectiveness that good inspection on a tight schedule ensures, and is a clear example of the arbitrary and capricious use of rulemaking authority.

FHWA has two major motives for this rulemaking: one is to satisfy the states' demands that FHWA get off their backs and quit making them look so bad. The other is to provide increasingly upbeat reports to Congress on the status of the nation's bridge program. A system whereby tens of thousands of bridges are each on a unique schedule of inspection insulates the agency from the jarring facts neatly summed in columns of numbers showing in each state how many bridges fall within, and how very many fall outside of, a 2-year inspection requirement. A corollary benefit of flexible schedules is that detection of violations of any given bridge's negotiated inspection cycle is virtually impossible; neither Congress nor private safety organizations like the Center can any longer assay the status of the states' compliance with the NBIS.

[In sum, Mr. Chairman, the variable inspection schedule proposal is a way for both FHWA and the states quickly to "get out from under." We believe the proposal is really a divide-and-conquer tactic that invites abuse because the FHWA has consistently shown that it is incapable of monitoring and enforcing compliance on the 2-year cycle. We think that it is highly probable that many states, currently prone to indulge a, let us say, unhurried approach to bridge inspection, will suffer relapse on the partial gains made in the past couple of years. The argument that FHWA would perform adequate oversight is not only belied by its inadequate enforcement conduct since the start of the NBIS, but is underscored by the manner in which the agency is capable of monitoring compliance with Federal inspection standards. As NTSB pointed out in the Chickasawbogue bridge report,

> The FHWA's annual reviews or 'paper audits', whether they are performed by FHWA division, regional, or headquarters staff, are extremely limited in scope and probably only ensure that the State is checking the boxes on the SIAA form.

We see no indication, Mr. Chairman, that the agency is planning a quantum leap in the extent or quality of oversight at any FHWA organizational level following a Final Rule on this docket. Moreover, if FHWA attempts to invest oversight responsibility for bridges under flexible inspection schedules in its Division Administrators, this is, in the first instance, the very management location for year-to-year administration of the NBIS that failed utterly to enforce the states' conformity to Federal law and regulation.

Let's take a look at the most recent Division Administrators' Annual Maintenance Reports to FHWA HQ. These reports require, in part, an annual fiscal year assessment of NBIS compliance. Despite the supposed high-profile, high-energy FHWA bridge management reform effort of the last two years, some Divisions did not file any NBIS report. Others sent in their maintenance reports that are supposed to be completed by October 1 and sent on through the Region to HQ, in May of 1987. Still others that have states with the worse bridge programs, bad across the board, filed terse reports with vague assertions of "state doing better," "compliance seems to be improving," "state doing the best it can," "still having some difficulty with locals." To us, Mr. Chairman, these phlegmatic comments are dangerous signals of what to expect in the way of vigorous oversight and enforcement if a variable inspection schedule is put in place.

- THE FHWA NBIS PROPOSED RULE: SAFETY

FHWA proclaims in its proposed rule that its implementation of a flexible schedule of inspections will result in "only a minimal or negligible increase in risk to the public." First, Mr. Chairman, it is a poignant, if not chilling, note that the FHWA is compelled to admit that, in order to legitimize the states' noncompliance with the NBIS inspection cycle, a relaxation of the 2-year cycle will result in more lives lost and more injuries sustained. One would have thought that the travelling public deserves better than this, having already suffered the loss of several lives in the collapse of the Schoharie Creek bridge only two days before this NPRM was published.

Secondly, we find nothing cited in this rulemaking proposal as a rational evaluation of the risks to the safety of the travelling public from a weakened NBIS, nor are we persuaded that, given the shambles that FHWA has allowed the NBIS to become since its start, the agency has any reliable means of quantifying risk. The claim that safety will be not much different that it is now, is a pretty obvious, and pretty lame, post hoc rationalization; and one that, on a personal level, I find blood-chilling.

Lastly, it is currently a matter of record that states which have improved their bridge inspection cycle to conform to the two-year requirement have shown not only the improved cost efficiencies that have resulted for their overall bridge programs, but have also radically lowered the potential for bridge collapses, especially when a vigorous underwater inspection effort has been instituted. Alabama and Connecticut are two states, Mr. Chairman, that I must point out as favoring retention of the 2-year cycle. It must be emphasized that, until very recently, Alabama had one of the worst records of any state in complying with the requirements of the NBIS. We all know the bridge disasters -- Chickasawbogue and Mianus -- that occurred in these two states that evidently have played no small role in the willingness of two states to go against the flow. Having bridges fall down because of incompetent bridge management is a terrible way to have to get true religion, Mr.

Chairman, but it woke up these two states to the real-world consequences of poor and infrequent bridge inspection.

- BRIDGE PROGRAM POLICYMAKING: THE SHADES ARE DRAWN

We have just celebrated Thanksgiving, one of our country's most important holidays, Mr. Chairman, that confirms for us each year that we live in an open society.

So let's talk some turkey here about closed-door policymaking, about our national bridge program where the regulatory apparatus for controlling the use of public funds for durable, safe bridges is produced outside of public view, without rulemaking, without notice to or participation by the public.

- The Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges
- The Manual for Maintenance Inspection of Bridges
- The Bridge Inspector's Training Manual
- The Standard Specifications for Highway Bridges

These are the documents that are the guts of our national bridge program, documents that are authored and revised by FHWA and AASHTO in exclusive consultation, without public evaluation and critique, in violation of statutes created to control, to stop this kind of insulated utilization of one interest group's views as the preferred source of advice for agency policy. It's long past time for the FHWA to bring these documents out into the sunshine. The Manual for Maintenance Inspection of Bridges is cited as a requirement in 23 CFR Pt. 650 -- in a footnote. It has never been put through rulemaking.

The Standard Specifications for Highway Bridges is the design manual that delineates the construction techniques and materials, and counsels the engineering judgments to be used, in building and restoring bridges. Currently in its 12th full edition, with interim specifications issued recently, it is amended by AASHTO and FHWA without public participation through rulemaking.

The Bridge Inspector's Training Manual, which specifies techniques, equipment, and training prerequisites and goals -- never put through rulemaking.

The Recording and Coding Guide, which selects the bridge features to inspect and how to weigh the results in the scales of structural integrity vs safety, the inventory and appraisal system that is the heart of the states' decisions of what bridges to repair, which to replace -- a new draft edition has just come out, Mr. Chairman, a joint production of FHWA and AASHTO alone.

And this, Mr. Chairman, is not the end of the story. We have all sorts of other regulations issued by the FHWA that never get near the Federal Register, much less entered in the CFR, that are laundered through internal memoranda to Regions and Divisions. Did you or your staff know, for example, that FHWA has required each state to have a well-founded underwater inspection program? Neither did we, until we uncovered a reference to it in records secured through a Freedom of Information Act request just a few months ago.

When was it issued as a Federal Register Final Rule? No, it was an internal memorandum from FHWA HQ to its Regions dated June 26, 1985. And, by the way, Mr. Chairman, despite four FOIA requests in just the past year for bridge program records from FHWA, two of them alone on just the underwater inspection program, we still have not seen this memo. Instead of asking for public comment on the nature of improved underwater inspection programs in a Federal Register NPRM, FHWA preferred to establish state grantee requirements by casting the new responsibility into a management communication from one level of the agency to another.

It's time for closed-door policymaking in the bridge program to end, Mr. Chairman. It's time to open up the major controlling documents of the bridge program to the scrutiny of a wider professional public through public notice and comment rulemaking in the Federal Register. Let's open the doors and pull up the shades.

- CONCLUSION

As we said at the outset of these remarks, Mr. Chairman, this bridge program is in serious trouble. A combination of tinkering with existing NBIS regulations, especially a weakening of the current 2-year inspection cycle, and FHWA trying to jawbone the states into better bridge programs, is just not enough. We think that Congress must ensure that at least the following major actions are undertaken in order to convert our national bridge program into an effective instrument for the safe and cost-effective use of Federal-aid bridge funds:

1) Retain the 2-year inspection cycle until sound research and field experience establishes other justifiable intervals that optimally generate inspection data that can ensure cost-effective maintenance and HBRRP replacement/rehabilitation work, and, moreover, guarantee the safety of the travelling public.

2) The NBIS must be improved especially with regard to the nature and quality of interim inspections of deficient bridges. FHWA must issue standards specifically geared to ensuring high-quality, documented interim inspections.

3) A National Underwater Inspection Program must be produced at the Federal level that specifies the exact techniques, equipment, personnel qualifications, and intervals required to ensure timely detection of underwater support deficiencies and their repair. This must be proposed for public evaluation in the Federal Register.

4) The FHWA must produce a Bridge Management System model for use by each state and the agency must approve each state's BMS. Each approved BMS must include written criteria for all phases and processes of inventory, inspection, maintenance, personnel qualifications, HBRRP project selection, and post-project cost-effective evaluation. The model generated by FHWA must be offered for public evaluation in the Federal Register.

5) FHWA must issue maintenance performance standards that specify the goals of state maintenance of Federally-assisted bridges and

set forth the management techniques and strategies that will achieve these goals to ensure compliance with 23 U.S.C. § 116. This must be offered as proposed rulemaking in the Federal Register.

6) FHWA must mandate the present, or appropriately rulemaking-modified, Federal NBI format of the Recording and Coding Guide as a requirement for all jurisdictions to use when inventorying and inspecting bridges. Too much data is being lost in translating different state and local inventory and inspection forms into the Federal format. In other words, the Guide should be made a uniform Federal standard and amended through rulemaking.

7) The other major FHWA/AASHTO documents itemized on p. 20 of our testimony must be put through rulemaking so that a wider and more varied professional public can assess the adequacy of these centrally important manuals and standards.

8) Congress must continue to keep all bridges twenty feet or more in length eligible for HBRRP, even given the currently reduced § 144 authorization figures. Removing entire classes of bridges from the HBRRP anytime in the foreseeable future would produce a national public works disaster.

9) Congress should seriously consider establishing specific statutory maintenance, NBIS, and HBRRP requirements for local jurisdictions given the reluctance and legal inability of many states to persuade or compel counties and cities to observe current bridge law and

regulation./

This is the minimum that must be done as soon as possible, Mr. Chairman. We cannot go on conducting business as usual in the face of what we know now to be the systematic failure of both FHWA and the states to abide by even the minimal regulations that now exist. And, if we may be so bold, we do not think that these and probably other actions by Congress and the FHWA can wait until another multi-year authorization bill is considered in 1991 or thereabouts. The defects we have uncovered are a call to action that cannot be deferred for another four or five years.

[And we also believe that very few if any of these recommendations will be acted on by the FHWA or the states absent the leadership and statutory command of this Congress. Tomorrow you will be presented testimony by FHWA that will downplay all of these mistakes and failures and tell you to be patient, that compliance is a difficult thing to achieve and that the states are short of personnel, short of money, but are well-intentioned and trying hard. AASHTO will tell you that the states are eminently responsible in their bridge programs, that they are using both Federal and state bridge money effectively, that the safety of the travelling public is well in hand and that freak accidents can happen despite the best of intentions and the best efforts. They will tell you that they don't need bridge management systems to be mandated by FHWA, they don't need statutory maintenance goals, they can work out all the kinks with present regulations -- no more is needed.

FHWA, not surprisingly, will second all of these AASHTO denials of need. The tale of the reluctant bridgegroom palls in comparison with FHWA the reluctant, if not fearful, regulator. Let's make no mistake about what this agency stands for, what its motives are in dealing with the festering problems of our national bridge program.

This is the agency, Mr. Chairman, that ineffectually administered a bridge program for years and years that was rife with chronic non-compliance and sustained abuse of Federal funds until the Center's suit and the collapse of the Mianus and Chickasawbogue bridges jerked its head from the sand.

This is the agency that tried once before in 1983 to satisfy AASHTO's demands for a weakened Federal presence in the bridge program, an attempt that fell with the Mianus Bridge.

This is the agency that in 1985 trumpeted its so-called management overhaul of the bridge program while offering to this Public Works Committee in 1986 a legislative proposal that would have knocked 75% -- 431,310 -- of the nation's bridges off the Federal HBRRP program and dump the safety of our citizens into the laps of the states, many of which had neither the manpower, the knowledge, or the money to improve bridge inspection, maintenance and rehabilitation.

This is the agency that on national television this past Spring proclaims that the most recent major collapse was not due to human failures, not due to bad design, not due to irresponsible inspection and maintenance, but to inexorable, irrestible forces of nature.

This is the agency, Mr. Chairman, that expresses total astonishment and disbelief over the collapse of one great bridge after another, but who is a mjor participant in that subtle interplay of negligent management decisions, inept policy choices, and the many, many day-to-day sins of omission in overseeing our national bridge program in the field, that ultimately led to the collapse of a mighty bridge with its helpless human cargo into the surging floodwaters of Schoharie Creek on April 5, 1987. / end

[Whereupon, at 3:10 p.m., the subcommittee was recessed subject to the call of the Chair.]

BRIDGE SAFETY

WEDNESDAY, DECEMBER 2, 1987

House of Representatives,
Subcommittee on Investigations and Oversight,
Committee on Public Works and Transportation,
Washington, DC.

The subcommittee met, pursuant to recess, at 10:18 a.m., in room 2167, Rayburn House Office Building, Hon. James L. Oberstar [chairman of the subcommittee] presiding.

Mr. Oberstar. The Subcommittee on Investigations and Oversight will come to order. The Chair apologizes for the delay. I was in the Senate side of the Capitol this morning testifying on the other side of the podium, at the hearing of the President's Commission on Privatization, making a statement with respect to the nation's air traffic control system.

The hearings yesterday gave the subcommittee some very important and oftentimes startling insights into the condition of the nation's bridges and our bridge inspection program. We heard from the National Transportation Safety Board that inspection deficiencies were involved in the collapse of the Mianus, the Chickasawbogue, and the Schoharie Creek bridges and that the Federal Highway Administration's annual reviews of state bridge inspection programs are essentially paper audits.

Spokesmen for the state departments of transportation indicated that while most States do not oppose the proposed rulemaking that would allow for less frequent bridge inspections, they did not necessarily indicate they would change from their current bridge inspection procedures. In fact, some said they flat-out would not.

Finally, the Center for Auto Safety called for the retention of the existing two-year inspection cycle and improvement of the existing national bridge inspection standards and state underwater inspection programs.

In the Notice of Proposed Rulemaking (NPRM) that the Federal Highway Administration has issued, we will be looking at the various implications of those concerns expressed yesterday, but we will also look at the reference made in that NPRM to flexible schedules of bridge inspection; specifically that such flexible scheduling will result in "only minimal or negligible increase in risk to the public."

I think we need to explore the implications of that statement more thoroughly, especially as it relates to public safety and economic benefits.

Today we will hear from the agency that oversees the national bridge inspection program and from a bridge consultant who works with state and local governments.

If there is no objection, the opening statement of Ms. Bentley will appear in the record at this point.

[Ms. Bentley's prepared statement follows:]

OPENING STATEMENT OF REP. HELEN DELICH BENTLEY

Chairman Oberstar and Ranking Republican Member, Mr. Clinger, I commend both of you for calling this two-day oversight hearing designed to review the federal role in the bridge inspection program.

Sudden collapse of bridges throughout the nation increases public awareness of the importance of the federal government's role in ensuring that bridges are properly inspected and continue to meet minimum safety requirements. The National Bridge Inspection Standards came into effect in April of 1971. It was December of 1967, that forty-six lives were lost as a result of the collapse of the Silver Bridge at Point Pleasant, West Virginia.

Recently, several older bridges in the northeast region of the United States also collapsed causing fatal accidents and extensive damage to vital infrastructure connections. Investment in our infrastructure will help save the U.S. taxpayer millions of dollars in future redevelopment.

However, before much needed infrastructure repairs can be accomplished, safety inspections must be properly performed to ensure user safety and highway maintenance.

Hopefully this hearing will result in assuring that safety inspections are adequate and performed to protect the public as much as possible.

As a member of Congress who represents the 2nd Congressional District of Maryland, I represent one of the older areas of our country and bridges in the northeast are the most subject to decay. Harsh winters, snow, ice and older infrastructure facilities such as bridges deteriorate faster in the northeast region of our country.

I look forward to receiving the testimony provided to this subcommittee and plan to work closely with my colleagues to address more efficient measures to eliminate government duplication. Effective implementation of safety inspection procedures by the federal government of our nation's bridges is imperative.

Mr. **OBERSTAR**. Does the gentleman from Pennsylvania have some opening comments?

Mr. **CLINGER**. Thank you, Mr. Chairman.

I would reiterate your comments and say that we heard some very interesting testimony yesterday which raised a number of questions. I am looking forward to hearing our witnesses this morning respond to some of the concerns raised yesterday. I look forward to hearing the testimony today.

Mr. **OBERSTAR**. Thank you.

Our witnesses this morning are Mr. Richard D. Morgan, executive director, Federal Highway Administration (FHWA), accompanied by Mr. Stanley Gordon, chief of the bridge division.

Welcome to the hearing, gentlemen. Would you please rise and raise your right hand. Do you solemnly swear that the testimony you give before the subcommittee will be the truth, the whole truth, and nothing but the truth, so help you God?

Mr. **MORGAN**. I do.

Mr. **GORDON**. I do.

Mr. **OBERSTAR**. Thank you.

We have your prepared statement. It is relatively brief, and you may read it in its entirety. Proceed as you choose.

TESTIMONY OF RICHARD D. MORGAN, EXECUTIVE DIRECTOR, FEDERAL HIGHWAY ADMINISTRATION, ACCOMPANIED BY STANLEY GORDON, CHIEF, BRIDGE DIVISION

Mr. **Morgan**. Mr. Chairman, I believe I will just submit it for the record. I have a couple of opening remarks.

Mr. **Oberstar**. Please feel free to go right ahead.

Mr. **Morgan**. I would say that it is appropriate that these hearings are convened at this time because this month is the 20th anniversary of the Silver Bridge collapse in Ohio, which really started us on the road that we are on now. The national bridge inspection standards, of course, originated as a result of that collapse. They first covered only the Federal-aid system. They have gone through an evolution where now they cover all bridges on public roads. And as you pointed out, we are now in the process of revising the national bridge inspection standards again.

The rule itself is under internal review within the Department of Transportation at this time. We propose to—I won't say change the frequency, Mr. Chairman—rather we expect the two-year frequency will still remain, but we are providing latitude for extending the frequency under certain conditions, with approval of the Federal Highway Administration. Of course, we also expect there are many bridges which will be inspected more frequently than the two-year period.

We also in that rule emphasize that all bridges with fracture-critical members be identified and special procedures be developed by the States to handle those bridges.

The rule also provides that the States will maintain a list of structures requiring underwater inspection and require underwater inspections at a maximum frequency of every five years.

Another part of the rule, Mr. Chairman, will permit inspection team leaders to be other than professional engineers if they are certified either at Level III or Level IV by the National Institute for Certification of Engineering Technologies.

That is the real crux of the major changes in the rule, Mr. Chairman, and I would be pleased now to answer any questions you may have.

Mr. **Oberstar**. Mr. Morgan, I think that statement may go down in the record books of this subcommittee as the shortest ever delivered by a witness to this subcommittee. [Laughter.]

Your full prepared statement will appear in the record following your oral testimony.

Let's begin with the questions raised in the subcommittee's letter to Mr. Barnhart. We wanted you to address and give us somewhat of a summary of your analysis of the, I believe, 63 comments that were received in response to the NPRM. Could you sort of categorize the principal concerns raised and the issues presented in the responses received?

Mr. **Morgan**. Yes, sir. There were five general areas of the rule, and all commenters did not, naturally, cover the five areas. The one that received the most comment was the proposed change in inspection frequency. There were 61 comments, and most of them were from State Departments of Transportation, although there were other comments from local Government agencies, consumer groups, other Federal agencies, professional societies, consulting firms, private citizens, and one Member of Congress.

There was a preponderance of support for providing some flexibility in the inspection frequency. There were also concerns expressed, which I believe were also brought out at the hearing yesterday—I read some of the statements—that this would amount to a relaxation and could have an impact on safety.

On balance, our decision was, as a result of the comments, to maintain a two-year frequency as a norm but permit exceptions under certain conditions.

The comments on the fracture-critical members provision, which requires that they be listed, identified, and inspection procedures be set up—and it's a similar type of arrangement for underwater inspections—expressed strong support that this be done, and that the States and the bridge owners should be required to identify the fracture-critical members and bridges which require underwater inspections, and provide special procedures for those. So, that is proposed in the final rule.

The change in inspector qualifications, and the change in the regulations requiring a quicker turnaround on submitting load posting records to Federal Highway Administration were not very controversial, and received support. So, we are proposing those changes.

That, Mr. Chairman, is a real quick summary of the comments.

Mr. **Oberstar**. Those are the principal categories of concern expressed.

What impact on oversight and safety do you anticipate if the current two-year inspection frequency is lengthened?

Mr. **Morgan**. I hope there is no adverse impact on either oversight or safety. We would not make the change if we thought there would be an adverse impact on oversight and safety.

The oversight issue perhaps is simpler because that is a question of approving a State plan and then monitoring that plan to see that it's carried out. As far as any categorization or tabulation of frequencies, that is relatively simple to do with the computer programs we have.

Regarding the impact on safety, I would hope there would be a positive impact on safety, and I hope I am not naive in that. The real purpose of permitting some flexibility in an inspection cycle is to permit the bridge owner to really put the bridge inspection resources where they are needed most; in other words, concentrate on the bridges that could give problems. On certain bridges, with good histories of performance and which by experience, we know are probably not susceptible to catastrophic failure, the frequency can be extended. And we do recommend a maximum four-year frequency for any type of structure.

Mr. **Oberstar**. Now, that matter of targeting resources is one, frankly, the Chair agrees with. I don't think you would find any disagreement with members of the subcommittee nor with any of the witnesses yesterday who represented a fairly broad cross-section.

The question is how do you target those resources and how do you get the most out of the people and the funds and the time, frankly, at hand if you have large numbers of bridges that need inspection, you have only so many people that can only do so much, you have divided jurisdiction between the federal, state, and then local governments and toll entities who may be independent agencies on their own, not subject to direct regulation, only hortatory pressure from the state?

So, how do you concentrate those resources in giving this greater flexibility and say look first at the biggest problem areas and focus more effectively, do more in-depth inspections of those bridges most subject to flooding, those bridges in areas that have experienced a natural disaster, whether it's flood or snow or earthquake or whatever? How do you envision that happening in this gray flexibility area?

Mr. **Morgan**. Well, I would expect that a State desiring to take advantage of the flexibility would develop a plan for doing so which would include any toll authorities, and all the local entities who are bridge owners in the State. It would be one plan, and we would look to the State to see that this was carried out.

It's not that simple, as you point out, with the different Governmental agencies involved responsible for the structures within the State, but it becomes—actually it is—a management problem on both the States' part and our part. Candidly, it's more difficult to manage something like this than it is to just give a rote calendar two-year inspection frequency.

But I also believe that the inspections can be, under a more flexible plan, much more comprehensive and that they can identify where their problem bridges are. These bridges have been there, and they know where the problem bridges are.

Mr. **Oberstar**. Well, AASHTO in its testimony referred to its own maintenance inspection of bridges manual and provided this language: "the maximum inspection interval may be increased and/or the depth of the inspection may vary for certain types or groups of bridges where such action is justified by past inspection reports and favorable experience and analysis."

I don't expect you to retain every word of that, but you get the thrust of it.

My question about that language and about the NPRM is its lack of specificity: "past inspection reports," "favorable experience and analysis." How do you measure that?

Mr. **Morgan**. I would say that you measure that using the existing bridge inventory. Now, I would not expect that we would get much uniformity among the States if that is the only guidance that goes out, Mr. Chairman. We intend to put out what we call a technical advisory, which is additional instructions, covering more specifically what we would expect from this so-called "record of experience," describing perhaps the types of structure for which that we would expect the frequency could be extended.

Mr. **Oberstar**. Technical advisory?

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar**. And that would be issued only after notice of final rulemaking?

Mr. **Morgan**. We hope to have it out the door at the same time the rule hits or shortly after.

Mr. **Oberstar**. And could you give us perhaps some examples of the kinds of information that would cover?

Mr. **Morgan**. Well, the technical advisory will cover the bridge inspection in general, with emphasis on the underwater inspection, the inspection of fracture-critical members, and the identification of the type of structure where we would expect the frequency of inspection could be extended.

Some simple examples of those are concrete box culverts that are relatively new and have shown good behavior. Short-span concrete structures generally behave themselves quite well in the first several years, 20-30 years of their life. So, there are structures out there that are quite dependable.

Also, it will cover the importance of knowing what is riding on this structure. In other words, the structure itself supports loads. Now, the loads are changing, as we all know, and we have to be, and each State and owner has to be, very knowledgeable about what that bridge is actually carrying and will carry.

Mr. **Oberstar**. Certainly.

Mr. **Morgan**. And that would bear on inspection frequency.

Mr. **Oberstar**. That is a matter I want to return to later on, the bridge formula and the truck pressure on bridges.

One of the witnesses yesterday suggested that for new bridges, for example, have an annual inspection for two years; if that doesn't show any defects or had defects that were corrected satisfactorily, that they then could envision a longer interval without inspection. What is your response to that?

Mr. **Morgan**. It may not be a bad idea, Mr. Chairman. On a new bridge, I would expect it would have, of course, an inspection when the bridge is accepted, followed probably by a good look at it when it's been in operation or use for a period of months—I mean fairly quickly, not even a year, to make sure that it's still behaving itself—then, perhaps again at some period after that.

It really depends on the type of structure and the degree of risk involved, as the different types of structures have different risks. But as a general rule, I can't find much fault with that. But, again, it's a rote type of inspection on a calendar, and I would prefer to do it more on an engineering basis. That is why we are leaving it open.

Mr. **Oberstar**. I was just looking at and reviewing my notes. Bridges that may not require a two-year inspection are those that are built under design standards, and those that have multiredundant features——

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar** [continuing]. Or those which are over land, over railroads, over other road surfaces. But the witness said in those cases there should be two complete inspections within a two-year period, and then, that witness said, you could envision a somewhat longer interval and concentrate your resources. That was in the context of concentrating resources on more visible problem areas. And you would feel comfortable with that approach?

Mr. **Morgan**. Yes, sir. If the State elected to go that route, I would have no problem with it.

Mr. **Oberstar**. I will have further questions.

I would now call on the gentleman from Pennsylvania.

Mr. **Clinger**. Thank you very much, Mr. Chairman.

Mr. Morgan, you alluded to the bridge inventory. Can you tell me what that inventory consists of at the present time?

Mr. MORGAN. I may have my numbers wrong, Mr. Clinger, but it contains an inventory of about 550,000 bridges on all public roads.

Mr. CLINGER. And that is maintained at FHWA?

Mr. MORGAN. We maintain a central file in headquarters. It is compiled from data furnished us by the individual States.

Mr. CLINGER. How extensive the inventory? In other words, does it indicate the design of those bridges?

Mr. MORGAN. Yes, sir. It's a fairly extensive inventory system: design, age, type of structure.

Mr. CLINGER. Condition of the structure?

Mr. MORGAN. Yes, sir. Condition of both the substructure, the superstructure; the structural condition as well as the functional condition, the width, whether it meets standards; the loads it carries, the traffic. Quite extensive. Each bridge inventory sheet contains just a wealth of information.

Mr. CLINGER. Is that inventory updated as inspections are made?

Mr. MORGAN. Yes, sir. As each inspection is made, we expect the data to be submitted, the revised data to be submitted into the inventory within 90 days of the inspection, I believe.

Mr. CLINGER. And what do you use that inventory for?

Mr. MORGAN. The inventory is used at the State level for prioritization of bridge projects, with apportioned bridge funds and Federal aid bridge funds. It's used at the Federal level actually as a basis for apportioning the Federal bridge replacement and rehabilitation funds. And we also use the——

Mr. CLINGER. That is the principal tool FHWA uses for the apportionment of funds?

Mr. MORGAN. Yes, sir, that is the tool. We also use it for a report to Congress on the conditions of the Nation's bridges, the annual report to Congress. That information is used to develop that report.

Mr. CLINGER. Could you utilize the inventory in its present form to make long-range projections as to repair, replacement and rehabilitation needs? In other words, can we use that in the capital budgeting sense to determine what our needs may be one, five, ten years out?

Mr. MORGAN. Yes, sir. In fact, we are adapting it to better use it in that regard as far as projecting future needs. Right now, the basis of the inventory is strictly whether it meets standards both structural and geometric in its various elements. We intend to revise that a little bit to reflect whether the bridge performs a level of service that it's expected to.

Now, that is not a play on words, and it's probably beyond the scope of the hearing, but for future needs projection, raw needs aren't usually a good indication because you have seen many big numbers that say these are the needs. But when you translate those needs into what you expect of the system, whatever part of the infrastructure it is, how you want it to perform, it's a much more realistic look at the needs than the raw needs whether it meets standards or not.

Mr. CLINGER. Can we use the inventory in another way, for example, where we have a disaster ue to a design failure like that which occurred in Connecticut. Could the inventory then be used to identify where similarly designed bridges are located across the country?

Mr. MORGAN. Oh, yes.

Mr. CLINGER. And would allow the proper people to be alerted to the fact that a danger exists?

Mr. MORGAN. Yes. We used it that way.

Mr. CLINGER. Was it used in that case?

Mr. MORGAN. Yes, sir. In Mianus.

Mr. CLINGER. The Mianus situation?

Mr. MORGAN. Yes, sir.

Mr. CLINGER. And States that have similar bridges were notified?

Mr. MORGAN. We notified, actually, the whole country to be alert to that kind of structure, but we had a handle on approximately how many there were.

Mr. CLINGER. Mr. Morgan, on May 14, 1985, FHWA sent out a letter signed by you to the regional offices in which you emphasized the need for better compliance by the States with the NBIS. The letter also required the submission of plans from the States as to how they were going to improve their compliance with the NBIS, a plan to correct deficiencies that might be identified.

The letter also suggested that FHWA might withhold Federal funds for noncompliance. Would you give us the current status of compliance with the requirements of the letter. Have there been any sanctions imposed by FHWA for noncompliance?

Mr. MORGAN. Mr. Clinger, when we sent the memo out, our two major deficiencies in the national bridge inspection system were load posting and frequency of inspection. We estimated that at the time of the memorandum there were 49,000 bridges nationwide which should have been load-posted, but were not. Right now we estimate the number is about 24,000. That number is probably less because we are aware that two States that made up a major portion of that 24,000 have recently taken action to post the bridges, but it doesn't appear in the inventory. So, in essence, the records indicate we have cut the problem in half. I think we are a little better than that. But that's where we are now in the load posting.

As far as inspection frequency, when we initiated our memorandum there were close to 85,000 structures with inspections over three years old. Today we believe—our records indicate that there are about 44,000 whose inspections are over two years old. That again is probably within 10 percent, no more no less, because the data keeps coming in. That is really—you asked about sanctions?

Mr. CLINGER. Yes.

Mr. MORGAN. There have been over 400 jurisdictions or geographic areas within States that have had project approvals withheld. Most of those have since been released as they come into compliance. We estimate that there are probably over 100 out there now that are still under the sanction of no Federal aid project approvals.

Mr. CLINGER. The funds are being withheld?

Mr. MORGAN. Yes, sir.

Mr. CLINGER. As an incentive to achieve compliance?

Mr. MORGAN. Yes.

Mr. CLINGER. So, you think it works?

Mr. MORGAN. It appears to work, yes.

Mr. CLINGER. It gets the states' attention.

Mr. MORGAN. It's not a very desirable way to go, but when all else fails, that's what we have.

Mr. CLINGER. Well, that's true. I mean, the purpose is to improve bridge safety.

Mr. MORGAN. Yes,sir.

Mr. CLINGER. So, if you withhold funds, that can be done.

Mr. MORGAN. It's counterproductive, but it works.

Mr. CLINGER. Returning to the bridge inventory for a moment. My understanding is that FHWA was able to use it as a means of alerting other jurisdictions with bridges with designs similiar to Mianus existed.

Mr. MORGAN. Yes.

Mr. CLINGER. But you could not use it to provide similar notification after the Schoharie collapse because that bridge was on a spread footing rather than pilings.

Mr. MORGAN. Yes.

Mr. CLINGER. And that type of design feature was not noted in the inventory. So my question is this: Some witnesses yesterday testified about the need for more design detail in the inspection report forms which go into the inventory. For example, information indicating bridges built on spread footings. I gather there has been some indication that the bridge reporting forms, the inspection forms, are under revision.

Mr. MORGAN. Yes, sir.

Mr. CLINGER. Would one of the purposes of that revision be to include more design information so that, for example, we would have been able to notify jurisdictions with bridges similar to Schoharie of the danger?

Mr. MORGAN. Mr. Clinger, I can't say for sure whether we will get into specific details. But the purpose of the revision is obviously to include more pertinent information and get rid of the information that we really don't need. The form itself is quite lengthy right now and there is probably information in there that isn't needed. But it's such a multipurpose form, used for everything from project prioritization to distribution of funds, that there has to be a certain core of information.

Mr. CLINGER. Well, it seems to me that this is the one way we really have of identifying and disseminating information nationwide, to inform those areas that might have problem bridges.

Mr. MORGAN. Yes, sir.

Mr. CLINGER. Maybe we ought to be taking a closer look at those kinds of bridges.

I have further questions, Mr. Chairman, but I believe my time has expired.

Mr. OBERSTAR. Thank you.

The gentlewoman from Connecticut?

Mrs. JOHNSON. Thank you, Mr. Chairman.

Welcome, Mr. Morgan. It's a pleasure to have you with us. I appreciate your testimony, particularly in regard to your efforts to involve local governments in the whole bridge inspection issue and to require their compliance.

I also commend you on your effort to learn from recent disasters by changing Federal aid procedures for new bridges. Yesterday we heard from Commissioner Burns of Connecticut DOT how we in Connecticut have changed our requirements in regard to new bridges to give greater attention to fracture-critical details both in construction and inspection. Connecticut is also requiring those who design the bridges to be involved in designing maintenance and inspection manuals.

I am sure that all of this was a joint effort. FHWA was very much a part of the investigations of the Mianus Bridge collapse and it's nice to see that changes are occurring not only in Connecticut but at the federal level as well.

Another important part of Commissioner Burns's testimony was the effect of the Mianus collapse had on our program. I think one of the most useful changes in our program has been the change in the paperwork required to assure inspection follow-ups.

You mention in your testimony that in the new proposed rule, you have proposed that FHWA will require special inspection and follow-up procedures for bridges with fracture-critical members, for bridges requiring underwater inspections and other bridges requiring special inspections.

What does FHWA mean by follow-up?

Mr. MORGAN. The way I interpret that—and I hope it's interpreted throughout the States that way—is that once a deficiency is found or a susceptibility to, for instance, scour or some other type of failure, then either corrective action is taken or perhaps more frequent monitoring is done to look at the situation and, when the time is ripe, correct it and feed, of course, that back into the system.

Mrs. JOHNSON. I was looking at a more practical aspect. Would you envision now that when Federal bridge personnel go in to check whether State programs are complying with Federal mandates, would also look to see what the paper trail is through which you can examine whether or not States took action on the recommendations of their own inspectors, and would you also check to see whether action taken was timely and appropriate?

Mr. MORGAN. Absolutely. Absolutely.

Mrs. JOHNSON. So you will be developing some guidance for your own people as to what constitutes adequate follow-up action by States?

Mr. MORGAN. Absolutely, Ms. Johnson. I am extremely interested professionally, as an engineer and in my job, in quality in all aspects of our highway engineering, design, construction, and maintenance. Quality of the inspection and quality of the system that is put in and how they operate it is really the key. The paper trail is relatively meaningless. The paper trail is good indication that a system is in place, but whether it is a true quality system and whether it operates is the key.

Mrs. JOHNSON. That brings me precisely to my next question. One of the recommendations that was made yesterday was to have Federal inspectors conduct some parallel inspections and then compare their results with those obtained by State inspectors.

I don't know how else we could evaluate State performance unless we occasionally conduct spot checks to give us some sense of the quality of State inspection work.

The second suggestion that was proposed was that Federal inspectors arrive on the scene during State inspections. I wonder if FHWA is considering any of these ideas? Are you looking to adopt that mode of oversight? And if not, why not?

Mr. MORGAN. Regarding your first point, having Federal inspections made parallel, we actually have used that in a couple of instances where in a discretionary bridge program we have questioned some of the ratings that came in. I have asked our field people to check it independently themselves and rate the bridge. Generally, it's correlated fairly well.

I have discussed with Mr. Gordon the possibility of teams crossing the State lines, for instance, to check uniformity because a good bridge in the East may be a bad bridge in the West, or the same with pavement conditions. You see it's subjective; it's whatever you're used to. I have talked about perhaps crossing State lines because, as I say, it's a safety issue but it's also a resource distribution issue. That is the data we use to give out bridge funds, to apportion bridge funds.

Mrs. JOHNSON. That is an interesting possibility because it would save us from developing the inspection resources ourselves.

Mr. MORGAN. Exactly.

Mrs. JOHNSON. And it would also better educate State inspection teams.

Mr. MORGAN. We do have under development, which should be ready by the end of this fiscal year, a demonstration project on bridge inspection. Now, I hate to use the term demonstration project on the Public Works Committee. It's not really what we are used to. [Laughter.]

It's out of our demonstration project division, where we package the latest state of the art in equipment and techniques in some vans, along with video tapes, and take it out to the States or the local agencies and show them what a proper method of inspection is, where the pitfalls are, what equipment is available. That is currently under development.

Mrs. JOHNSON. I think that would be quite useful. But I would hope that as a result of these hearings, FHWA would develop some very specific procedures and guidance in regard to the issue of conducting oversight by repeating State inspections. Everyone needs to be accountable. We had good people in Connecticut who cared a lot running our bridge system before the Mianus Bridge collapsed.

The fact that we in Connecticut have had to make such radical changes in our program, a program which had been approved as being a good program year after year by FHWA, a program filled with good people, knowledgeable people who were dedicated to the goals of the program, the fact that this program had to be so radically changed in order to live up to what we view as good indicates that we need to do new things.

As you say in your testimony, I think it's a matter of maturation and of changing circumstances, and it is not to say that because we're going to make these changes now that the people involved before were of ill-will, malicious, or incompetent.

I would hope to see from the department some specific, direct action on this issue of repeating certain inspections more frequently than you have in the past, so that we can build in greater accountability.

Lastly, to return to the issue of the extended-frequency of inspection, would you foresee then, in light of your earlier comments and in light of your description of the guidance you hope to issue, that States would be looking to extend intervals only for certain types of bridges. Would you say that increased frequencies would not be extended for bridges with fracture-critical elements or with underwater spread footings? Is that a fair statement?

Mr. MORGAN. That is a fair statement.

Mrs. JOHNSON. I just wanted to make that clear for the record.

Mr. Chairman, I do have a few more questions, but as I have taken my time, I yield back.

Mr. OBERSTAR. I thank the gentlelady.

Just following up on that point that you made in response to Ms. Johnson, the training film and training program for local governments is a good idea and very important. It needs to be done. We heard a good deal of testimony yesterday about qualifications of inspectors at all levels, and I want to come back to that later.

But there was also concern expressed that local governments don't have the resources and may not even want to know about deficiencies they have on these bridges because they are going to have to spend money to fix them up. So, they just take their sweet time about it because they don't have the resources.

Do you have any concern that local governments in some instances, not as a general rule, don't really want to know about the problems because they would be then faced with the financial problem of having to either repair it or close it off?

Mr. MORGAN. I expect, Mr. Chairman, that exists and probably will continue to exist, and I really don't think that we will ever cure that completely.

The one incentive that local bridge owners have, of course, is a liability issue. I don't believe the fact they don't know the bridge was bad, if it falls in, is a defense— though I am not a practicing attorney. But I do think that the liability issue should at least get their attention.

Mr. OBERSTAR. You're quite right.

Mr. MORGAN. We have gotten their attention, by and large, over the last several years, resulting in much better performance at the local level.

Mr. OBERSTAR. Well, you do make reference in your testimony—I think Mr. Clinger touched on it earlier—to withholding funds from those local jurisdictions that refuse to do the load posting. That is vitally important in the spring, for example, in both the highway surface as well as on bridges. Are there any areas of the country that are responding better than others to the promptings on load postings?

Mr. MORGAN. The major deficiencies that are left in the load posting area are on local systems and some of the southwestern States.

Mr. OBERSTAR. How can the authority of the Federal Government be brought to bear more effectively to bring those entities into compliance?

Mr. **Morgan**. Well, I think that it has been brought together quite effectively. I do not anticipate we will ever achieve 100 percent compliance.

Mr. **Oberstar**. Well, 100 percent is pretty tough in that area.

Mr. **Morgan**. That's very tough.

Mr. **Oberstar**. I understand. I am not seeking perfection. But I do want to protect the greatest number of lives possible.

Mr. **Morgan**. I also have a belief that the States and local Governments have a vital interest in protecting their own citizens. I don't believe it's all a Federal responsibility.

Mr. **Oberstar**. But, you know, sometimes, Mr. Morgan, you have probably been to some meetings where it is helpful for that county commissioner or for that township officer to say that, "Daggone old Federal Government is making us do this, and we've got to do it. And I don't like it, and we're going to have to raise the levy here, but there's no other way to do it, because the Feds are down our backs."

You know, and what they're saying inside of themselves is, "You know, we've got an out." And that pressure, that continued pressure, is the most beneficial factor that we have on those local governments.

I have been at township officer meetings and county board meetings, and they just raise literal hell at times about these Federal regulations, and I just smile and say, "It's a country of laws, and you've got to stick with it."

Mr. **Morgan**. We intend, Mr. Oberstar, to keep the heat on.

Mr. **Oberstar**. What data formed the basis for the current five-year interval for underwater inspections?

Mr. **Morgan**. That five-year interval I believe is contained in the AASHTO manual, and it is just the collective best judgment of the top bridge engineers in each state, which we endorse.

Mr. **Oberstar**. Now, yesterday, despite questioning, we could not find any database, any body of evidence. It just sort of grew "like Topsy," to coin a phrase from literature.

Mr. **Morgan**. I can't disagree with that. I can't point to any studies that we've done that say five years is better than ten or two. As I say, I think it's experience.

I do think that as the States are required—and most of them are doing it right now—to inventory their bridges that require underwater inspections and make the inspections, they will develop a knowledge, a better knowledge base of what the frequency should be.

But there are certain givens or engineering judgment calls that can be made, I believe, without a whole lot of research and data. A stream that is susceptible to scour ought to be inspected after every flood or highwater or rapid-runoff situation. And brackish water, perhaps, where it's still your main problem is piling corrosion, once you've looked at it and watched it for a while, that probably can be extended.

So, there are certain parameters, but I think we do have to know more about it. We now have a contract with a Dr. Richardson at the University of Colorado to develop some guidelines for inspection of scour-susceptible locations.

Mr. **Oberstar**. Well, that is very important, and you are clearly aware of all the factors.

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar**. And that is very reassuring.

How many States are in compliance with that five-year interval for underwater inspection?

Mr. **Morgan**. They are—right now, there are 47 States that have identified the bridges. There are 43 of them, if I recall, that are actually going through the inspection cycle. How many are in exact compliance with the five-year, I would have to supply for the record; I don't have that right with me.

Mr. **Oberstar**. That would be in your paper audit file?

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar**. Please do that. We would like to have that information.

[Information received from Mr. Morgan follows:]

Of the 50 States, Puerto Rico and the District of Columbia reporting on the status of their Underwater Inspection Program, 39 have established a 5 year or less frequency for underwater inspection. Seventeen States have now completed their underwater inspection and are considered to be in complete compliance. An additional 22 report a completion date of late 1988. The few remaining States anticipate completion early in 1989 to 1993. Five States have not as yet established completion dates.

Mr. **Oberstar**. Now, given the very clear awareness that you have of the factors of scour, floods, fast streams, brackish water, salt water, why aren't those special conditions addressed in a particular way in the NPRM?

Mr. **Morgan**. Our general preference is to keep a lot of technical details out of our formal rules and supply that guidance by a technical advisory or another technical publication. We intend to put such information and guidance into our technical advisory or a subsequent publication.

Mr. **Oberstar**. What impact does the technical advisory have?

Mr. **Morgan**. Its legal status, it's basically a manual of good practice, Mr. Oberstar, of how to do things. But officially it has no regulatory status. From a practical standpoint, it's quite persuasive.

Mr. **Oberstar**. We heard testimony yesterday of real concern about this too-cozy relationship between the Federal Highway Administration and AASHTO, as it was described. Too great a willingness to allow these matters to the imagination in the individual states, and leave in nonregulatory status some very important items.

I will recognize the gentlewoman in a moment.

I would like to hear your response to that. I mean, on a matter that is so important, where the principal category, the largest category of bridge failures is those involved with flooding.

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar**. And scour and other such water-related factors, it seems to me a higher degree of regulatory attention should be paid to those categories.

Mr. **Morgan**. I think whether it's regulatory or technical or required, I would have to agree with you. That is why we have emphasized that in the regulations, that they have to develop an identification and an inspection program for those particular types of structures.

Now, with regard to, I guess, the comment, allegation, or concept that there is a cozy relationship and we make requirements nonregulatory because they're easy to get around, I guess that is sometimes an inside-the-beltway concept of how the Federal-aid highway program works. But I am here to assure you that isn't what happens. That memorandum I signed out two years ago was in no way regulatory; it had no status other than something I signed to our field offices asking them to straighten out the bridge program. And it was done.

Mr. **Oberstar**. Excuse me. I will have to yield to the gentlewoman.

Mrs. **Johnson**. I just wanted to know if there are any court cases that to indicate that your manuals are viewed as sort of the state of the art, which gives them a certain enforcement influence that they wouldn't have through rulemaking. Other areas manuals of that sort have functioned effectively to require compliance in a sense because they are legally recognized to be clear standard.

So, I just wanted to mention this because I, too, have reservations about putting everything in the regulations. On the other hand, as the Chairman says, this is a very important matter. I just wondered whether there was any judicial history on those publications.

Mr. **Oberstar**. Mr. Morgan just indicated that the technical advisory, as a manual of good practice, has no legal standing.

Is that correct?

Mr. **Morgan**. Yes, sir.

Mrs. **Johnson**. That's true, but often these things become used by the courts and take on an almost legally recognized standard. Are there any court cases that would give us a sense of how these manuals are viewed when litigation is involved?

Mr. **Morgan**. I am sure there are, and I can't specifically point to a manual. But in years past, when we first started becoming a much more litigious society, several of our directives were phrased in terms of "should's," "may's," and they were interpreted by the courts as mandatory. It was mainly in the environmental area. That's when we evolved into a completely regulatory type of approach to our directives.

But the technical advisories and AASHTO design manuals can be standards. Some are incorporated into our regulations by reference, some as guides, which is really a manual of good practice. I believe the courts would look on those probably a little differently. If it's the only game in town, that's what they use.

When we put out a technical advisory on any subject—and we have them out in many technical areas from hydraulics to bridges to pavements—they become, you might say, the standard of review, for our field offices, of State operations, and if there are deviations, the deviations have to be supported. It flows over on the States.

So, while I have mentioned they have no firm legal status, they do become often a standard of review as opposed to a standard of performance.

Mr. **Oberstar**. Well, this committee was born in the early years of the National System of Interstate and Defense Highways. In the wake of widespread reports of fraud and corruption which were then substantiated by the subsequent hearings of this subcommittee and my predecessor in Congress, whose portrait hangs on the wall, former chairman of this committee, Mr. Blatnik. Thirty-six people went to Federal prison. State manuals were rewritten. State laws were rewritten as a result of the hearings of this committee because of cozy relationships, because of unwritten ways of doing things, very serious matters of taking money, taking bribes, delivering or providing stubs for gravel that was never delivered and cement that was never poured.

There were no internal audit or review practices of any national uniformity among the states. All that was changed as a result of the work of this subcommittee.

We don't want to see us drift back into kind of a "give the greatest flexibility possible; trust the folks to do the right thing." We want to do that, and we should be able to. But all systems, we find in our inquiry into safety work, are better when there is someone looking over your shoulder. I have constituents looking over my shoulder. We are looking over yours. You are looking over the states', and they are looking over the local governments', and that kind of keeps everybody in line.

One of our witnesses yesterday, referring to four separate documents—manual for maintenance, inspection of bridges, bridge inspectors training manual, standards specifications for highway bridges—and said, "These are the documents that are the guts of our national bridge program, documents that are authored and revised by the Federal Highway Administration and AASHTO in exclusive consultation, without public evaluation and critique, in violation of statutes created to control, to stop this kind of insulated utilization of one interest group's views as the preferred source of advice for agency policy," and calls for bringing these documents out into the sun.

And while I respect AASHTO immensely, these are professionals in highway programs throughout the country, it is true that the process by which they arrive at this document is a closed process. It's not open to the public. I don't think they close it because they don't want people to hear, because they are afraid of public scrutiny, but because they are technical folks, they're engineers who have a high degree of professionalism and feel they're doing their job and it need not be open to public scrutiny.

And yet the Code of Federal Regulations for the Federal Highway Administration by specific reference says, Part 650.303(a) under Subpart C, National Bridge Inspection Standards, says, "Each highway department shall," and goes on, et cetera, "in accordance with the provisions of the AASHTO Manual and the Standards contained herein."

You are adopting AASHTO's manual in toto without subjecting it to this public national rulemaking process. Have you ever given that some thought about the inconsistency of the process?

Mr. **MORGAN**. A good deal of thought. With regard to the manual, to me, when that was published or incorporated into the regulation, into the NPRM, it became just as much a target for comment as the rest of the NPRM. So, if somebody was in basic disagreement, that's open for comment.

I don't look at it as a backhanded way of developing standards. It is again a manual of good practice, in essence, which has been a model for the way that you should do bridge inspections and inventory.

Now, I don't, Mr. Chairman, put myself up as an apologist for AASHTO or the states.

Mr. **Oberstar**. No, I didn't expect you to be.

Mr. **Morgan**. The Federal Government has a role and the states have a role, and I don't always agree with AASHTO or the individual states and they don't always agree with us. It's going to stay that way, I'm sure, but that's the way the rules are set out. We have our job to do. My paycheck is green. [Laughter.]

Mr. **Oberstar**. Well, I think it's important to give a little further thought to subjecting what AASHTO does, if it's going to be incorporated in the Code of Federal Regulations, to this broader public scrutiny and public openness.

In the current rulemaking, the Federal Highway Administration says that the flexible schedule of bridge inspections will result in "only a minimal or a negligible increase in risk to the public."

In 1984, when the Federal Highway Administration withdrew a similar rulemaking, the statement said, the "Federal Highway Administration has determined that the proposed inspection interval increase is not in the best interest of public safety. Further, it is believed that the safety benefits of the existing regulations far outweigh any potential economic benefits of an increased inspection frequency."

Why did you change your mind? What is the body of data upon which you base the change in frequency interval?

Mr. **Morgan**. Well, first, Mr. Chairman, the frequency interval is only changed at the state's election and with support. Two years is still the basic frequency in our proposed final rule, not necessarily in the NPRM.

We have developed three more years of experience, and we have developed inspection procedures, on which to base a judgment on when the frequency could be expanded. I can't claim any research or breakthrough that, as a result the light suddenly shone. I believe, though, that based on engineering judgment, based on the inventory we have and what we know about our bridges, that in some cases the frequency can be extended.

Mr. **Oberstar**. So, the final rulemaking will maintain the two-year standard but establish procedures for states to have a longer inspection interval. The state will have to submit, as your statement in the Federal Register says, analysis with supporting data justifying the increased time interval, and then you cite the relevant factors, the four that you, I believe, cited earlier.

Are those four factors going to be accompanied by something somewhat more specific so that you have a little better yardstick by which to measure?

Mr. **Morgan**. I think the additional guidance on those factors will be in, as I say, our technical advisory.

Mr. **Oberstar**. So, there will be a technical advisory issued to provide further guidance on those points?

Mr. **Morgan**. yes, sir.

Mr. Oberstar. And you will have a better way of judging and perhaps somewhat more uniform national standard by which to measure states who wish to have a longer interval?

Mr. Morgan. Yes, sir.

Mr. Oberstar. Why is there a longer interval for underwater inspections than for aboveground inspections?

Mr. Morgan. Well, again, the underwater inspection is a maximum, and it could be less, but once——

Mr. Oberstar. My point is shouldn't it be less?

Mr. Morgan. Pardon me?

Mr. Oberstar. Shouldn't it be a shorter frequency, just to hold people's feet to the fire?

Mr. Morgan. Not necessarily.

Mr. Oberstar. Aren't structures that are underwater subject to greater degrees of corrosion?

Mr. Morgan. In saltwater, perhaps.

Mr. Oberstar. In salt and brackish water surely.

Mr. Morgan. The perils for underwater structures are pretty well known. I mean, you may either have a scour problem or you may have a pile corrosion problem.

Mr. Gordon, are there any others?

Mr. Gordon. No. It's the type of design of the structure. If the structure is in a scourable location, then of course it has to be looked at more frequently, and these are determinations that the state highway departments usually make because they know the type of footings their bridges rest on and whether the streams that they rest in are scourable-type streams or not.

Mr. Oberstar. Does the Federal Highway Administration look over their shoulder and see if in fact they are categorizing their bridges and conducting more frequent reviews of, let's say, high-probability danger areas?

Mr. Gordon. Yes. We will be getting into this, especially with the new rule. They will group their bridges into bridges that are susceptible to scour. Now, the five-year inspection period is pretty much accepted by the profession for a bridge that has a good pile foundation. But that is just a starting point. Then you look at the type of details, and if it's scourable or if it's a spread footing or if it's on alluvials, this is the type of thing that has to be looked at more frequently, and it will be grouped that way. That is what we will be watching for.

Mr. Oberstar. I will yield at this point to the gentleman from Pennsylvania.

Mr. Clinger. Thank you very much, Mr. Chairman.

Just following up on that line of questioning. In the Schoharie situation, it appears that scour may have played a major role, although we don't have the final report. But it does appear that scour was certainly a major contributing factor. We also had some indication that not all of the States are aware of the dangers posed by scour and what their implications may be.

Following up on the chairman's question, has FHWA, either alone or in conjunction with AASHTO, conducted any research on this? I gather, Mr. Gordon, that perhaps you have.

Mr. Gordon. On April 17, 1987, we put out an all-inclusive memorandum to all States through organizational channels, and we submitted to them all the backup information that we had made available over the years with respect to inspection for scours, what to look for, where to look. We submitted the criteria that was put out by NCHRP. They put out a Synthesis 88, which I will be happy to present for the record, and Synthesis 251, which actually gives criteria for inspection underwater. We circulated that nationwide at that very time.

Mr. CLINGER. And that was April of this year?

Mr. GORDON. That was April of 1987, soon after the disaster. That was one of the emergency actions we took immediately.

Mr. CLINGER. I wonder if we might have a copy of that submitted for the record.

Mr. OBERSTAR. Submit that document if you have it available now. If not, send that in to the committee. The Chair would ask unanimous consent to include the document at this point in the record.

[Documents are retained in subcommittee files.]

Mr. CLINGER. Do you feel that document to be sufficient guidance to the States on the issue of scour, or do you have any plans to update it?

Mr. MORGAN. Yes, sir. I had mentioned earlier that we did have a contract active right now that we are developing further guidance with.

Mr. CLINGER. Which again will be distributed to the States?

Mr. MORGAN. Yes, sir.

Mr. CLINGER. Do you have a process for evaluating State programs and determining their effectiveness or lack thereof?

Mr. MORGAN. Well, through our field offices. I have discussed with Mr. Gordon recently that in the next couple of years we want a much higher emphasis on reviewing the quality of the State inspections and follow-up activities as opposed to just the numbers, the fact that the blocks are checked and it comes in every two years, because that is really where the proof of this all is.

Mr. CLINGER. And does that go back again to what Congresswoman Johnson was talking about?

Mr. MORGAN. Yes.

Mr. CLINGER. The possibility of including spot checks of the performance of State inspection teams?

Mr. MORGAN. Yes. It has to be. We have to spot—you can check a process, but until you follow it up with a product check, you're really not sure of how it works. So, we will be doing some field checks, absolutely.

Mr. CLINGER. But at the moment, your evaluation of the thoroughness of a State program is basically based on a paper audit?

Mr. MORGAN. No, sir. Our structural engineers in the field right now have been advised and instructed that it's more than just paper. They will go out with a State on inspections and review the inspection teams, their qualifications, and how they perform—not with the idea of catching them doing something wrong, but with the idea of making sure it's done right.

There will be more emphasis, though—I would like to put a little headquarters emphasis on it to coordinate our regions and divisions on this whole area to looking at quality with, let's say, technical exchange across State lines and across our regional lines, looking for more uniformity of inspection also.

Mr. Clinger. At the present time, are there any State programs that you would deem to be totally inadequate?

Mr. Morgan. *Inadequate?*

Mr. Clinger. Inadequate.

Mr. Morgan. No, sir, not that I am aware of. I am not going to say they're perfect. I know there are a lot of them that I feel have room for a lot of improvement; others are at a relatively high level.

Mr. Clinger. It seems to me that there has to be a fair amount of variance between state programs.

Mr. Morgan. Yes, sir.

Mr. Clinger. For example, yesterday we heard from the deputy commissioner from New York State who showed us the manual which NY DOT has developed, which goes quite far beyond what the Federal manual presently requires. But I gather that New York's program would be rather sophisticated in comparison with some other State programs. Is that correct?

Mr. Morgan. They have a—they have a good program, yes, sir. They have a good program. And again, the proof of anything, they could have the greatest program in the world, but if they're not going to commit resources to it—and I am not saying they're not—the real proof is going behind and seeing if the thing is actually working. That is what really we are interested in concentrating on over the next couple of years.

But, Mr. Clinger—and you're all aware of this, but for the record, there are 1,300 engineers in the entire Federal Highway Administration. Of those, there is probably a hundred that my friend Gordon represents, structural specialists. We have 550,000 bridges, we have a $14-plus billion program. I am not trying to convince the Committee or would even accept the responsibility that we know everything that is going on. If somebody wants to beat us on something, they're going to beat us, frankly. We may catch them in the long run, but it's a program built—it's a State program that's built a lot on professional trust, and we do have oversight responsibility, which I believe we fulfill. But we are not miracle-workers, and I am here to tell you that we don't know everything that's happening.

Mr. Clinger. Right. But clearly, States aren't in the business of building faulty bridges.

Mr. Morgan. No, sir.

Mr. Clinger. I mean, they have an interest in assuring public safety as well because of the potential liability they face.

Mr. Morgan. Of course.

Mr. Clinger. One of the issues that came out yesterday which I would like for you to respond to is, that we're not building a lot of new bridges because we've pretty well fulfilled the need for new bridges. We are repairing and building replacement bridges. However, there is really no Federal money available for maintenance. As we are obviously in a time of fiscal austerity and budget crunches around here. Would you think it might be advisable that the law be changed to permit some of the bridge formula money to be used for maintenance, if indeed maintenance is a way that we can forestall or obviate the need for major repair, rehabilitation or replacement, which deferred maintenance often leads to?

Mr. MORGAN. Yes, sir.

Mr. CLINGER. Wouldn't it make sense for Federal funds to be used to fund routine maintenance?

Mr. MORGAN. Yes, *sir, it could make sense.* But I am not for it.

Mr. CLINGER. Okay. Why not?

Mr. MORGAN. Well, it gets the Feds involved—and I mean, involved—setting the rules and the guidelines and oversight on something that is traditionally a State and local responsibility. I believe that they ought to fulfill that responsibility.

Now, I don't know what the carrot is to get everybody up to speed. Maintenance money is short, and you know it from back home. In any State or local it's very short. And often, deferring maintenance——

Mr. CLINGER. That is often the thing that gets cut first.

Mr. MORGAN. That takes it in the neck, so we'll let it go till it's bad enough to be eligible for Federal aid funds. Well, I decry that philosophy, but I am sure that it's out there someplace.

I think in our next shot at the highway bill in 1991, that's something that really has to be looked at because truly to keep our bridges and our entire highway infrastructure in decent shape, you have to manage that system all the way from inventory through maintenance and design. It all has to be put together, and the inspection system we're talking about is only good—it's only good if it feeds into some action, and it has to feed into the maintenance.

In fact, the answer, and something we've been pushing for the last 18 months and are going to continue to push in this area is a bridge management system, total bridge management, which encompasses all the disciplines and really tells you when to maintain that bridge, how to maintain it, when to reconstruct it, and so forth. That is good resource allocation.

Now, perhaps—and we looked at this in the last highway bill but it didn't sell very well on the Hill—the block grant approach with the idea that funds could be used for highway purposes perhaps without as much restriction. I think I'd probably cut it off at plowing snow and cutting grass. But if it extends the service life of the infrastructure, perhaps it should be an eligible item for Federal aid, and perhaps a different look at the way the program runs right now is in order in the next cycle of highway legislation.

Mr. CLINGER. Well, I would certainly agree with that, because I think right now we, as you say, basically provide incentives for people to let things deteriorate to the point where they do qualify for Federal aid and therefore the whole thing ends up costing more money than if minimal maintenance had been provided.

Mr. MORGAN. It's the same way with our pavements.

Mr. CLINGER. Thank you very much, gentlemen.

Thank you, Mr. Chairman.

Mr. OBERSTAR. Before I call on Mrs. Johnson, I want to follow up on the point Mr. Clinger raised. I was intrigued with your comment that you are directing Federal inspectors to go out with the State inspectors on the job and not just sit back and do principally paper audits.

How many of these inspections, hands-on inspections, are Federal inspectors conducting? Give us a little more detail about that practice. In how many areas of the country is this actually being done?

Mr. **Morgan**. Well, I would hope—and I will supply more detail for the record if I may be permitted——

Mr. **Oberstar**. Please do.

Mr. **Morgan**. We have a structural engineer in each State, at least one, in our office. Part of his job is to oversee the State national bridge inspection program performance.

Mr. **Oberstar**. Now, each state has a district engineer.

Mr. **Morgan**. The division office. Yes, sir. Division Administrator.

Mr. **Oberstar**. Division engineer, yes. Are all functions, highway functions, consolidated under that person?

Mr. **Morgan**. Yes, sir. He has a staff.

Mr. **Oberstar**. So, he has a staff. And would there be one person who does as a major part of his bridge inspection work?

Mr. **Morgan**. Well, we have at least one structural engineer, and as high as three or four in some of the larger States, in each of our division offices. Part of his job, of course, is he reviews bridge plans. He works with the State on bridge designs. But part of his function is oversight of the State bridge inspection program. That is part of his function.

Mr. **Oberstar**. Yes. You see, my concern was——

Mr. **Morgan**. He doesn't have it as a full-time job, no, sir.

Mr. **Oberstar**. Right. My concern is that I know the division engineers over the years in the State of Minnesota, they are spread so thin.

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar**. I just wonder aloud whether that person would have enough time, have the ability actually to go out and do that work. I think it's very important, and it should, it should be done. But you're really faced with the problem of manpower; right?

Mr. **Morgan**. Absolutely.

Mr. **Oberstar**. The more of that hands-on inspection that can be done the better. Well, we will return to that, and please do submit that information for the record.

Mr. **Morgan**. Yes, sir.

[Information received from Mr. Morgan follows:]

The Federal Highway Administration (FHWA) Region and Division bridge engineers visited an average of 25 bridge sites in each State in 1987 to compare inspection reports on specific bridges with the FHWA engineer's observations at the site. This comparison procedure is considered an important step in FHWA's oversight of the bridge inspection program in each State. To further evaluate the inspection program, the FHWA bridge engineers observed 125 bridge inspection teams in action to evaluate the quality and thoroughness of inspection during 1987.

Mr. **Oberstar**. Mrs. Johnson, thank you for your patience.

Mrs. **Johnson**. Thank you very much, Mr. Chairman.

I would only add to the comments that the chairman has made, that it is from that detail that both FHWA and Congress can better determine whether we are able to develop a more effective oversight procedure in the coming years. The need to review the quality of what happens on site in an inspection is simply too important to let slide by. It is clear from what has happened that we have to be part of that action in some way or another. It is clear that FHWA has a number of ideas, and you certainly are committed. But that is one of the things that we will be looking for in a year when you come back to talk to us.

The maintenance issue has been well discussed, so I am going to wind up with a couple of specific things. One is that I hope that in this new guidance that you put out—and I am not an expert, I am merely saying that it sounded logical yesterday—that we not automatically assume that new bridges are good bridges. I think the suggestion that bridges, to qualify for any kind of extended interval of inspection, would have had to have earned a good reputation by having survived a pattern of scrutiny.

Commissioner Burns said that he felt that they needed to get to know their new bridges, that they needed to inspect them more often in the beginning. So, we would look for that in the guidance in terms of inspection of new bridges.

Specifically, in regard to the underwater inspections issue, has FHWA specifically incorporated NTSB's recommendations in regard to underwater inspections? It was our impression yesterday that you have not.

Mr. GORDON. Yes, we have, as a matter of fact. In fact, we asked NCHRP to have a research study done to look at that. We have as Mr. Morgan just alluded to earlier, retained Professor Richardson, of the University of Colorado, who is going to look at and give us a way of assessing the vulnerability of certain types of foundations in scourable streams so that we could issue that kind of a document.

Mrs. JOHNSON. Okay. And in planning that research, you have taken NTSB's recommendations for the development of criteria into account?

Mr. GORDON. Oh, yes.

Mrs. JOHNSON. Okay

Mr. Chairman, I think that concludes my questions, and I thank you.

Mr. OBERSTAR. Thank you.

Mr. Morgan, in the NPRM the statement is made that, "If 30 percent of the Nation's bridges can be demonstrated to warrant a two-year review cycle, an $8.4 million savings in annual inspection costs could be achieved."

How did you arrive at that number? First, the 30 percent.

Mr. MORGAN. I am not familiar with that number. Is that our number? I don't foresee any savings in bridge inspection costs by changing the frequency. Frankly, it's not our intent to save money by changing the frequency. The intent is to put the money where it does the most good; in other words, put the inspection effort on those structures that are more susceptible to deterioration.

So, I am sorry, Mr. Oberstar, I am not familiar with that number. If it came out of the NPRM, why, I will respond for the record.

Mr. OBERSTAR. I am just trying to find the exact page in here.

Mr. MORGAN. We do spend about $80 million a year. We estimate that we spend about $80 million a year on bridge inspections, and perhaps it's an extrapolation of that figure. But as I say, it's not an economy move, it's a management move, permitting the change in frequency.

Mr. **Oberstar**. I would certainly hope so. This is on the Tuesday, April 7th (1987) Federal Register, page 11095. Granted this is not the rulemaking itself, but it's the summary.

Column 2 on that page at the top, "If, for example, 30 percent of the Nation's bridges could be inspected at a four-year frequency rather than the two-year frequency, it is estimated that $8.4 million of annual inspection costs could be saved." That is in the summary, not in the body of the NPRM, but it reflects the thought process behind it.

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar**. So, someone in your agency cooked up 30 percent?

Mr. **Morgan**. I was afraid you'd find that in the Federal Register. I didn't know it was there.

[Laughter.]

Mr. **Oberstar**. I know I had seen it, and I just wanted to be sure that you had.

Mr. **Morgan**. Yes, sir. I will——

Mr. **Oberstar**. Find out on what basis that was made.

Mr. **Morgan**. Yes, sir.

[Information received from Mr. Morgan follows:]

In order to make a gross estimate of the possible number of bridges which may be candidates for inspection frequency periods of longer than 2 years, the National Bridge Inventory Data was used in the following manner:

Assume that all bridges in the following categories will continue to require inspection at least once every 2 years;

1. Structurally deficient bridges,
2. All bridges not structurally deficient with sufficiency ratings less than 50.0,
3. All load posted bridges,
4. All bridges which should be posted but are not coded as posted,
5. All bridges carrying more than 1000 vehicles per day,
6. Bridges more than 30 years old,
7. Bridges over navigable waterways, and
8. Bridges on defense highway systems.

A total of 454,000 of the Nation's 576,000 bridges are in one or more of the above categories. This leaves 122,000 bridges which are possible candidates.

Assuming that all of the remaining bridges do not have fracture critical members, require special underwater inspections or close monitoring for other reasons, the maximum shift of bridge inspection costs can be estimated as follows:

Assume an average cost of inspection for these bridges of $275.

Current Annual Inspection Costs for these bridges based upon inspection every 2 years are: 122,000 times $275 divided by 2 years equals $16.8 million.

If these bridges require inspection only once every 4 years, the annual inspection costs will be: 122,000 times $275 divided by 4 years equals $8.4 million.

Thus, a maximum amount of $8.4 million might be directed towards other inspections each year if all of the 122,000 bridges determined above pass other more detailed evaluation criteria for longer inspection periods.

Mr. **Oberstar**. At this time the Chair would like to recognize the gentlewoman from Maryland.

Mrs. **Bentley**. Thank you, Mr. Chairman.

Mr. Chairman, I ask unanimous consent to have an opening statement included in the record.

Mr. **Oberstar**. Without objection, so ordered.

Mrs. **Bentley**. Thank you.

Mr. Morgan, you may not be ready for this, but I would like it for the record. I would like to have a rundown of the inspections that have been conducted in the State of Maryland on bridges. I would appreciate having that included in the record.

Mr. MORGAN. Yes, ma'am.

[Information received from Mr. Morgan follows:]

FEDERAL HIGHWAY ADMINISTRATION, MARYLAND DIVISION

1986 NATIONAL BRIDGE INSPECTION STANDARDS EVALUATION

A review of the Maryland State Highway Administration, Frederick County and Washington County Bridge Inspection Program was conducted on December 15-17, 1986, to determine their compliance with the following elements of the National Bridge Inspection Standards:

1. Inspection Procedures.
2. Frequency of Inspection.
3. Qualification of Personnel.
4. Inspection Reports.
5. Inventory.
6. Underwater Inspection.

The following participated in the review:

Geoffrey Kolberg, Chief of Bureau of Bridge Inspection & Remedial Engineering, SHA.

Joe Miller, Assistant Bureau Chief, Bridge Inspection & Remedial Engineering, SHA.

Bob Giglio, Bridge Inspection and Remedial Engineering, SHA.

Al Hudack, Design Chief, Frederick Co.

Ken Harwood, Designer, Frederick Co.

Glenn L. Dull, County Engineer, Washington Co.

Joe Policelli, Structural Engineer, FHWA.

Neil Lacey, Engineer Trainee, FHWA.

William W. McDaniel, Project Engineer, Kennedy Bode & Porter Inc.

INSPECTION PROCEDURES

The State Highway Administration, Bureau of Bridge Inspection and Remedial Engineering, has responsibility for conducting inspections for bridges on the State highway system and for two of the 23 counties in the State. They also compute the load ratings for those structures and recommend structures for posting. The Bureau coordinates the Bridge Inspection Program for the remaining jurisdictions in the State and collects and edits inventory and inspection data for all bridges with a span of 20 feet or greater.

The bridge inspection unit within the Bureau is composed of four 3 man inspection teams. The teams are located on the Eastern Shore, in Frederick in the Baltimore area and Prince Georges County. All inspection teams are under the supervision of the Bridge Inspection Section Leader. Each inspection team has a van and the necessary equipment, including small boats, to perform inspections. Two snoopers are also available to be used by the teams as needed.

Frederick County inspects their bridges using their own forces. One of their design engineers and a technician inspect half of the 178 county bridges during a 4½ month period each year. The County has all of the necessary equipment to perform inspections including scaffolding and their own snooper vehicle.

Frederick County performed most of the load ratings for their bridges with consultants rating the remaining 25 percent of the bridges. The Chief Engineer for the county recommends posting and the Board of County Commissioners approves the postings. There are 47 country bridges with load postings.

Frederick County has identified those bridges with fracture critical members in the inventory. They rate the condition of the fracture critical member and the mark date of the inspection.

Washington County uses consultants to inspect and rate the 83 bridges under their jurisdiction. The City of Hagerstown also uses consultants to inspect their structures. All 34 bridges recommended for posting by the consultant have been posted. Bridges with fracture critical members will be identified during the next round of inspections in 1987.

POSTING

SHA has 126 State structures which have to be analyzed for load capacity. These structures have been assigned to consultants and structural engineers in the Bureau of Bridge Inspection and Remedial Engineering. The consultants have been given a completion date of April 1, 1987. Most of these structures will not require posting.

Most of the counties and cities have analyzed their structures for load carrying capacity and posted the structures. The following is a list of local governments with incomplete postings:

County	Bridges recomended for posting	Bridges posted
Baltimore	181	165
Carroll	38	32

FREQUENCY OF INSPECTION

At the time of this review all State bridges were being inspected at the required 2 year frequency.

All counties and the City of Baltimore were meeting the 2 year frequency requirement except the following listed counties and city:

Jurisdiction:	*Number of bridges not in compliance*
Carroll	2
Cecil	1
Montgomery	1
City of Salisbury	7
Worcester	33
MD Toll Authority	2
	46

Worcester County is 5 months behind schedule for the inspection of their bridges and SHA at the County's request will inspect the bridges using one of the consulting engineering firms under contract to the State.

There are also 55 bridges owned by the Federal Government that do not meet the 2 year frequency of inspection requirement.

QUALIFICATIONS OF PERSONNEL

The individual in charge of the four inspection teams has over 10 years of bridge inspection experience. The four team leaders have at least 5 years of bridge inspection experience.

Ten of the 12 men directly involved in bridge inspection attended a NHI one week bridge inspector training course in the Fall of 1985 in Baltimore. The team leaders and the supervisors had also attended previous training courses.

The Frederick County inspection team leader has attended a bridge inspector training course. Washington County uses consulting engineers who are registered professional engineers to inspect their bridges.

Dr. John Fisher of Lehigh University conducted training in November, 1986 for the bridge inspectors on inspection of steel bridges for fatigue damage and bridge designers on fatigue prone design details.

INSPECTION REPORTS

The following are comments on bridge inspection reports we checked in the field to verify the condition and appraisal ratings assigned to the structures:

BRIDGE NO. 170040—MD Route 838 over Wye Narrows in Queen Anne County. Satisfactory

BRIDGE NO. HO 0075—Foundry Street over Little Patuxent River in Howard County. Satisfactory

BRIDGE NO. W 3051—Mt. Lena Road over Beaver Creek in Washington County. Item 67 (Structural Condition) is coded 7 (condition better than minimum criteria). This should be coded as a 3 or 4 since the bridge is posted for 12 tons.

BRIDGE NO. W 2383—Beards Church Road over Little Antietam Creek in Washington County. Item 61 (Channel and Channel Protection) was coded N (Not Applicable). This item should have been rated since the structure crosses a stream. Item 67 was coded 6 (condition equal to present minimum criteria). This should be rated 3 or 4 since the bridge is posted for 10 tons.

BRIDGE NO. W 2521—Clopper Road over Antietam Creek in Washington County. Item 61 coded N. It should be rated, since it crosses a stream. Item 67 coded 7. The bridge is posted for 10 tons, Item 67 should be coded 3 or 4.

BRIDGE NO. W 2381—Old Forge Road over Marsh Run in Washington County. Item 61 should be rated since the structure crosses a stream. Item 67 rated 7. It should be a 3 or 4 since the bridge is posted for 10 tons.

BRIDGE NO. F 2101—Opussum Town Pike over Tuscorora Creek in Frederick County. Satisfactory

BRIDGE NO. F 0407—Structure crossing—Hunting Creek. Item 65 (Approach Roadway Alignment) should be reduced from a 7 to 4 because of impact on the structure. Item 67 was rated 5 (condition somewhat better than minimum adequacy to be tolerated being left in place as is). This should be coded as a 3 or 4 since the bridge is posted for 3 tons.

BRIDGE NO. F 0401—Blacks Mill Road over Hunting Creek in Frederick County. Item 67 should be reduced from a 6 to a 3 since the bridge is posted for 3 tons.

BRIDGE NO. CE 0003—Dr. Jack Road over Octoraro Creek in Cecil County. The consultant recommended that this bridge be closed to traffic, and it has been closed by the county. Item 67 (Structural Condition) was rated 5 and it should have been 2 or less. Item 59 (Superstructure Condition) was rated 5. It should have been rated 2, since the bottom chord of the truss had buckled.

STRUCTURE NO. BC 5303—Caton Avenue over I-95 in Baltimore City. Satisfactory

STRUCTURE NO. BC 5213—Hilton Street over Amtrak in Baltimore City. Item 58 (Deck Condition) and Item 60 (Substructure Condition) were rated 6. The deck and substructure condition should be rated 4.

The Bureau of Bridge Inspection and Remedial Engineering will contract with consultants to perform quality control inspections on 20 SHA bridges each year. Five bridge inspection reports from each of the four SHA bridge inspection teams will be checked each year.

INVENTORY

The SHA maintains a complete inventory of all highway structures with a span of 20 feet or greater. The following is a breakdown of the number of structures by jurisdiction:

Jurisdiction:	*No. of bridges*
State Highway Administration	2208
23 Counties and Baltimore City	2409
Maryland Toll Authority	140
U.S. Government	83
Private	1
Approximately	4841

There continues to be a problem with missing and incorrect data in the inventory portion of the SI&A sheet. These are listed under the Significant Findings portion of this report.

UNDERWATER INSPECTIONS

The SHA established criteria to identify those bridges which require underwater inspections. Maryland currently has 277 bridges under SHA jurisdiction which require underwater inspection. Underwater inspections were performed on most of those bridges in 1985 and 1986. Contracts have been awarded to consultants to inspect the remaining State bridges by the Summer of 1987. Maryland will maintain a 5 year frequency for underwater inspections. These inspections are performed using a diver with a Civil Engineering Degree and at least 5 years experience in underwater inspections. In addition, the diver must have at least 500 hours of underwater inspection experience on structures. The diver may substitute an additional 5 years of experience for a Civil Engineering Degree. SHA requires that the inspection company have a Registered Professional Engineer at the site during the inspection to oversee and coordinate the underwater inspection and prepare the inspection report. A member of the SHA District Office is also present during the inspection.

SHA also has an ongoing emergency contract with a diving company to perform emergency inspections after floods or at the request of the regular bridge inspection teams when a problem is suspected. These inspections may or may not take the place of a regular 5 year underwater inspection.

SHA has requested the counties to identify all bridges which will require an underwater inspection. The State has items in their bridge inventory to identify the structures that need an underwater inspection and the date of the last inspection.

Baltimore County has performed underwater inspections on their bridges as part of the most recent inspections. The other jurisdictions will perform the underwater inspections as part of the regularly scheduled inspection.

SIGNIFICANT FINDINGS AND RECOMMENDATIONS

1. There does not appear to be any established procedure to inspect, inventory and enter data for new or rehabilitated bridges in the State's inventory within the required 90 day period. Some of the new bridges on I-795 had been open to traffic for some time before they were inspected in October and November of 1986.

The District Construction Office should notify the Bureau of Bridge Inspection when a new bridge is completed and is due an inspection. The inspection should be performed before the bridge is open to traffic.

The counties should have their design consultant inspect a new or rehabilitated bridge when it is completed and fill out the SI&A computer input sheet.

2. The State Bureau of Highway Statistics is not furnishing the inventory portion of the SI&A data for new structures. Inventory data for the I-795 bridges has not been furnished to the Bureau of Bridge Inspection. There is also missing inventory data for many of the county structures.

SI&A data for Item 7 (Facility Carried by the Structure) and Item 9 (Bridge Location) are being furnished by the counties but the State is not placing this data in the computer. This is required data and has not been coded for State structures.

The Washington Office furnished the following information on errors in the State's Bridge Inventory data:

(a) There are 556 structures with Item 12 (Road Section Number) coded incorrectly.

(b) Thirteen bridges have data that is not numeric for Item 42 (Type Service).

(c) There are approximately 376 bridges that do not have functional class codes which are compatible with the highway system as coded. The records should be revised to reflect agreement between the SI&A Items 24 and 26. A listing of these bridges was furnished to the State.

3. There appears to be some confusion by some of the counties and their consultants on the rating of Item 67 (Structural Condition). Some structures were rated at 5 or higher and the bridges cannot carry a school bus.

4. An early date should be established to complete load ratings on the 126 State bridges. This may require that all structures be assigned to consultants for analysis.

5. There are several counties that have completed their load ratings but still have not completed the postings.

6. There has been a five month delay in the assignment of a consultant to inspect the Worcester County bridges. These bridges were due an inspection in July and August of 1986.

There are approximately 1400 county bridges that will be due an inspection in 1987. The counties should be alerted to provide for the inspection of these bridges by the due date.

7. The rating of SI&A Item 71 (Waterway Adequacy) and Item 72 (Approach Roadway Alignment) should be performed in the field by the inspector. SHA is making this appraisal in the Central Office.

8. There are 36 bridges on the Federal-aid system and 126 Off-system bridges that were built or reconstructed in the last 10 years and are classified as deficient. We are requesting justification from the State for this rating.

9. There are 62 bridges with Item 49 (Structure Length) that is blank or not numeric.

SUMMARY

Based on our review, we feel that the State is in general compliance with the requirements of the NBIS.

We compliment SHA on their successful effort to identify those bridges requiring underwater inspections and performing the inspections in a timely manner. The Special Provisions and criteria developed by SHA for underwater inspection contracts were furnished to all the States in this Region as a guide for them to use in the development of their underwater inspection program.

Emphasis needs to be placed on correcting and inputting missing data for both the State and locally owned structures in the inventory portion of the SI&A sheet.

An extra effort will also be required to keep the local governments on schedule for the inspection of approximately 1400 bridges in 1987.

FEDERAL HIGHWAY ADMINISTRATION MARYLAND DIVISION 1987 NATIONAL BRIDGE INSPECTION STANDARDS EVALUATION

A review of the Maryland State Highway Administration, Cecil County and Prince Georges County Bridge Inspection Program was conducted on May 26–28, 1987, to determine their compliance with the following elements of the National Bridge Inspection Standards:

1. Inspection Procedures.
2. Frequency of Inspection.
3. Qualification of Personnel.
4. Inspection Reports.
5. Inventory.
6. Underwater Inspection.

The following participated in the review:

Geoffrey Kolberg, Chief of Bureau of Bridge Inspection & Remedial Engineering, SHA.
Joe Miller, Assistant Bureau Chief, Bridge Inspection & Remedial Engineering, SHA.
Bob Giglio, Bridge Inspection and Remedial Engineering, SHA.
Barry G. Belford, Director of Public Works, Cecil County.
Tom Delorimer, Deputy Director of Public Works, Cecil County.
Ed Binseel, Assoc. Director of Public Works and Transportation, Prince Georges County.
Harry Price, District Engineer, Prince Georges County.
Jerry Potter, Director, Office of Structures, FHWA Region 3.
Robert Wood, Structural Engineer, FHWA Wash., DC.
Dennis Decker, Project Manager, FHWA Demonstration Projects Div.
Joe Policelli, Structural Engineer, FHWA MD Div.
John Formosa, Engineer Trainee, Region 3.

INSPECTION PROCEDURES

The State Highway Administration, Bureau of Bridge Inspection and Remedial Engineering, has responsibility for conducting inspections for bridges on the State highway system and for two of the 23 counties in the State. They also compute the load ratings for those structures and recommend structures for posting. The Bureau coordinates the Bridge Inspection Program for the remaining jurisdictions in the State and collects and edits inventory and inspection data for all bridges with a span of more than 20 feet.

The bridge inspection unit within the Bureau is composed of four 3-man inspection teams. The teams are located on the Eastern Shore, in Frederick in the Baltimore area and Prince Georges County. All inspection teams are under the supervision of the Chief of the Bureau of Bridge Inspection and Remedial Engineering. Each inspection team has a van and the necessary equipment, including small boats, to perform inspections. Two snoopers are also available to be used by the teams as needed. Each team also has a copy of the Bridge Inspector's Training Manual and the AASHTO Bridge Maintenance Manual.

The Bureau has established procedures whereby all bridge inspection reports for structures with significant defects are reviewed by a structural engineer. The structural engineer recommends action and the defect is corrected using District maintenance forces or by contractors under contract to the State.

Bridge inspectors, as part of their routine inspection, include recommendations for maintenance on the structure in the report. Maintenance recommendations are forwarded to the appropriate highway district for corrective action.

Consultants inspect and rate the 97 structures under the jurisdiction of Cecil County. All 53 structures recommended for posting by the consultants have been posted. Three bridges were closed as a result of the 1985 bridge inspections. The County Road Superintendents review the inspection reports to determine needed repairs. The county has not identified structures with fracture critical members. These structures will be identified by the consultant assigned by SHA to perform the inspections in 1987.

Prince Georges County requested SHA to assign a consultant to perform inspections on the 130 structures under the jurisdiction of the county and 12 structures owned by municipalities. Thirty-six bridges have been posted as a result of the 1985 inspections. The county has identified bridges with fractured critical members.

LOAD POSTING

All structures under SHA jurisdiction requiring posting are posted. There are 52 bridges owned by the State that are currently posted. Eight hundred and fifty-two bridges under the jurisdiction of the counties are posted. Worcester County and Wicomico County are in the process of posting 34 and 29 structures respectively. This will complete the posting of county bridges based on current bridge inspections and ratings.

FREQUENCY OF INSPECTION

All State bridges are being inspected at the required two-year frequency.

There is a total of 556 bridges in the counties that did not meet the frequency requirement in 1987. The following is a list of counties that did not comply with the two-year frequency of inspection requirement for all of their structures: Alleghany, Baltimore, Cecil, Prince Georges, and Wicomico.

All of the bridges in these counties that were due for an inspection in 1987 will be completed by January 1, 1988. Most of the inspections are being performed by consultants under contract with SHA. The State will deduct the inspection costs from the county's share of bridge funds.

Some counties have not been able to meet the two-year frequency of inspection requirement because of the lead time that is needed to hire a consultant to perform the inspections. Counties with approved consultant selection procedures indicate that it takes 9½ months to hire a consultant to perform the inspections. In the past, the State was reluctant to step in and assign one of their consultants to perform bridge inspections for the county if the county was in the consultant selection process. SHA has changed their position because of the large number of county-owned structures that did not comply with the frequency requirements in 1987.

The State currently has three consulting firms under contract to perform bridge inspections for the counties. They also plan to hire a consultant to manage the County Bridge Inspection Program. The SHA has established a procedure to assign one of their consultants to perform bridge inspection for a county if the county does not have a consultant under contract. The State will take this action sufficiently in advance of the inspection due dates to allow the State's consultants to perform the inspections in a timely manner.

QUALIFICATION OF PERSONNEL

The Assistant Bureau Chief of Bridge Inspection and Remedial Engineering is in charge of the four State bridge inspection teams. He is a registered professional engineer. The four team leaders have at least five years of bridge inspection experience.

All bridge inspectors have attended at least one bridge inspector training course. The State recently sent three inspectors to New Mexico State University to attend the bridge inspector training course.

INSPECTION REPORTS

The following are comments on bridge inspection reports we reviewed in the field during 1987 to verify the condition and appraisal ratings assigned to the structures:

Bridge No. AC02 (Henderson Avenue/CSX in Cumberland): Item 68 (Deck Geometry) and Item 72 (Approach Roadway Alignment) are rated 4. Both items should be rated 3. Item 69 (Underclearance—vertical and lateral) is coded N. It should be given a numerical rating. Item 58 (Deck Condition) is rated 5. It should be rated 4.

Bridge Nos. 0300781 (I–83/Pimlico Road) and 0300782: Item 58 is rated 5. It should be rated 4 since the deck is scheduled for replacement. Item 61 (Channel and Channel Protection) is rated 8. This item should not be rated since the bridge crosses a roadway. Item 36 (Traffic Safety Features) was not rated for Bridge No. 0300781.

Bridge No. 0300511 and 2 (I–83 N.B. over Falls Road and Jones Falls): Item 67 (Structural Condition) is rated 3. This should be rated 4 since the structure is not load posted and Item 59 (Superstructure Condition) and Item 60 (Substructure Condition) are rated 6 or higher. Item 71 Waterway Adequacy) is coded N. It should be rated since the bridges cross the Jones Falls stream.

Bridge No. CE0097 (Baron Road/B&O RR in Cecil County): Item 69 is coded N, it should be rated since the bridge crosses a railroad. Item 72 is coded 5, it should be rated 3.

Bridge No. CE0071 (Bailiff Road/Stoney Run in Cecil County): Item 41 is coded A, it should be coded P since the bridge is posted. Item 68 (Deck Geometry) is coded 2, it should be coded 3 or 4.

Bridge No. CE0078 over abandoned railroad in Cecil County: Item 71 (Waterway Adequacy) was rated. It should be coded N.

Bridge No. P0482 (Fenno Road/Mataponi Creek in Prince Georges County): Item 67 (Structural Condition) was coded 7. It should be coded 4 since the structure was posted.

Bridge No. P0498 (Fenno Road/Mataponi Creek in Prince Georges County): Ratings were satisfactory.

Bridge No. P0589 (Trump Hill Road/Charles Branch in Prince Georges County): Ratings were satisfactory.

Bridge No. P0599 (Governor's Bridge Road/Patuxent River in Prince Georges County): Posting sign was missing at one end of the bridge.

Bridge No. 1500363 (I-270 S.B./Rt. 109 and Bennett Creek in Montgomery County): Item 36 (Traffic Safety Features) was coded 1000. The bridge rail did not meet current standards and the transitions, approach guardrail and guardrail terminals did meet current standards. This item should have been coded 0111.

Bridge No. 1500364 (I-270 N.B./Rt. 109 and Bennett Creek): Same comment as above.

INVENTORY

The SHA maintains a complete inventory of all highway structures with a span of more than 20 feet. The following is a breakdown of the number of structures by jurisdiction:

Jurisdiction:	*No. of Bridges*
State Highway Administration	2298
23 Counties & Baltimore City	2153
Maryland Toll Authority	139
U.S. Government	77
Other	11
Total	4678

In the past, there was a problem with missing and incorrect data in the inventory portion of the SI and A sheet for both State and County bridges. The SHA Bureau of Highway Statistics has responsibility for coding these items. The inventory section of the SI&A is now complete for all State structures and progress is being made to code the inventory items for the county bridges.

The SHA has not conducted an inventory of all bridges on and off the Federal-aid system to determine their historic significance. This inventory should include locally owned structures.

UNDERWATER INSPECTIONS

SHA has identified 277 State-owned bridges that require underwater inspection. These structures are identified by coding a "D" (Diver required) in SI&A item number 340. SHA completed the underwater inspection of approximately 150 bridges in 1987. SHA is scheduling these inspections to meet the five year frequency requirement. All 277 bridges have been inspected using divers.

Twelve counties and Baltimore City have also identified bridges requiring underwater inspections. A diver will inspect these bridges during every other normal inspection or every four years.

SIGNIFICANT FINDINGS AND RECOMMENDATIONS

1. Five hundred and fifty-six locally owned structures did not meet the two-year frequency requirement. SHA has assigned consultants to complete these inspections by January 1, 1988 for the counties.
2. SHA has established procedures to assign consultants to inspect county bridges in a timely manner.
3. We recommend that counties advertising for consultant inspections include an option for a second round of inspections. Montgomery County has the option for three cycles of inspection with the same consultant. This will eliminate the nine months of lead time required to select a consultant every two years.
4. New highway legislation requires the State to complete an inventory of all bridges to determine their historic significance.

5. SHA will assign one of their consultants to perform quality control inspections on 12 State bridges (3 bridges from each SHA bridge inspection team). The consultants report will be compared to the SHA inspection reports to determine the adequacy of the SHA inspections and reports. The inspections are scheduled for February 1988. We recommend the quality control inspections be conducted every year.

6. The State and counties should identify all structures that are prone to collapse due to scour damage, for example, structures not founded on piles or rock. Corrective measures should be taken where possible.

7. It is our understanding that SHA plans to hire a consultant to manage the bridge inspection program for the counties. We believe it would be more cost effective for SHA to provide additional manpower and manage the program in house. A group could be established within the Bureau of Bridge Inspection and Remedial Engineering that would be solely responsible for conducting inspections on State bridges, managing the county bridge inspection program and performing quality control inspections for all jurisdictions.

8. We recommend SHA host the Bridge Management System Workshop to assist in the development of the State's Bridge Management System. This should be scheduled as soon as possible.

SUMMARY

The State is in compliance with the requirements of the National Bridge Inspection Standards except for the county structures that did not meet the frequency of inspection requirements. All structures that are due an inspection in 1987 will be inspected by January 1, 1988.

Mrs. **Bentley**. The one other question I have is that some States are using consultants to conduct part of their inspection activities. Now, are these consultants required to meet minimum qualifications required by the NBIS?

Mr. **Morgan**. Absolutely, yes, ma'am.

Mrs. **Bentley**. They are?

Mr. **Morgan**. Yes, ma'am.

Mrs. **Bentley**. Okay. And do you check to see that this is done, that they do have the minimum qualifications?

Mr. **Morgan**. On a spot basis.

Mrs. **Bentley**. On a spot basis?

Mr. **Morgan**. Yes, ma'am.

Mrs. **Bentley**. At random?

Mr. **Morgan**. Yes, ma'am.

Mrs. **Bentley**. All right. Unfortunately, I wasn't able to be here for your testimony, and I may want to submit additional questions to you in writing for the record.

Thank you.

Mr. **Oberstar**. Thank you.

One of the issues that has come up in the course of our inquiry is training: training of inspectors, training of divers for underwater inspections. Does the Federal Highway Administration envision promulgating standards for diver qualifications and diver training?

Let me put this in context in case you haven't been briefed by your staff. Yesterday there was some extensive discussion from the state highway officials about engineers who have taken up scuba diving and having the required training, gone down on a voluntary basis to do that inspection. Others, who are just divers on a contract basis don't have that experience of an engineer. For some relatively modest cost, $1,000 to $2,000 it was suggested, they can receive the training. If they don't have the training, they should be under the very close supervision of an engineer as they do that underwater inspection.

I don't see anything in the NPRM that addresses this matter, and I want to know what are your reactions. What is the Federal Highway Administration planning to do with this very important area of inspections?

Mr. MORGAN. We don't see setting standards is necessary at this point in time for the divers that they have to meet certain qualifications.

Mr. OBERSTAR. Why not?

Mr. MORGAN. We would leave that up, again, to the type of inspection they are going to do and to the State. The type of inspection that is required, underwater inspection, obviously will vary with the type of structure. At times, if the water is clear, a lot can be done with television and photography with an engineer accompanying the inspection, perhaps interpreting. Other times, perhaps, using a diver would be the only way you can get an adequate inspection, especially when you're looking at an impending failure. Then you should probably send—you should send an engineer down, a trained diver-engineer.

But it's tough to cover every situation, and I would think that if we set the elements of the inspection, what we expect out of an underwater inspection, I would leave it to the owning agency to determine how that is attained. And I would expect that as this becomes more routine, that we would be checking it in the field to see what types of folks they are using for divers. Some States will use scuba-trained engineers, others won't.

Mr. OBERSTAR. Could you require the states to supply the Federal Highway Administration with information about their diver inspection program?

Mr. MORGAN. Well, they will supply us, as part of the new regulation, an inventory of the bridges that need underwater inspections and how they propose to undertake these inspections, and that would be part of it.

Mr. OBERSTAR. It seems to me that there is great diversity. I am not opposed to diversity, but in areas of safety I feel more comfortable when there is a relatively narrow range of diversity and you can measure progress on safety.

This matter of training, it's not training just for bridge inspectors, Mr. Morgan. Our committee has conducted inquiries into aviation safety and the training of inspectors—Federal inspectors and aircraft companies and airline company inspectors—and find that a very great deal of responsibility is riding on the shoulders and on the experience of those people who are the first line of safety.

We found the same thing in the area of pipeline safety. What we find is a common thread, that you have to have very high standards, very high qualifications, and training for these people to keep up with the latest technology and developments. It just seems to me that in so important an area of underwater inspection it deserves mention and deserves reference in the rulemaking.

I don't think that Federal Highway is ready to publish a full set of standards on qualifications of underwater inspectors. I am not sure that there is agreement on the state of the art of that matter. But I think that it ought to be in there just to raise its visibility and to give the agency a little more authority in reviewing and keeping programs up to high standards.

I would just like you to consider that and think that through.

Mr. **Morgan**. You make a very valid point, and whether we change the rule or preamble or put it in subsequent instructions, I think probably there should be some—at least some—broad parameters of qualification for people that are responsible for that. We can't cop out on that one by turning it all over. We will give that serious consideration, Mr. Chairman.

Mr. **Oberstar**. Thank you. Please do. I think it's very important.

Also in the course of our inquiry, one thing that stands out like a sore thumb—inspections needed after unusual occurrences. You know what those are: floods, hurricanes, earthquakes. Does the rulemaking or current rules address the matter of inspection following such unusual occurrences?

Mr. **Gordon**. It doesn't currently, but it will with the new coding guide. We will be talking about inspections following floods.

Mr. **Oberstar**. With the new what?

Mr. **Gordon**. With the coding guide that sets out what to look for.

Mr. **Oberstar**. The current one, the January 1979?

Mr. **Gordon**. That is being revised now, reworked.

Mr. **Oberstar**. That is the current manual?

Mr. **Gordon**. All the new things we talked about this morning will be in this new coding guide.

Mr. **Oberstar**. And it will address the matter that we just talked about, unusual occurrences inspections?

Mr. **Gordon**. It will address the significance of underwater inspection in describing how to fill out the box.

Mr. **Oberstar**. Do you have something in draft form on that issue? Not necessarily with you now, but if you have a draft document?

Mr. **Gordon**. I don't have it with me.

Mr. **Oberstar**. We would like for you to share that with the subcommittee, not for inclusion in the record, because it is still in preparation stage, but for our review just to be familiar with the stage at which you are now working.

Mr. **Gordon**. But, you know, all State highway departments know that it's virtually impossible currently to inspect bridges for scour during the time when you should be looking at it. When you should be looking at bridges for scour is at the time of flood level, and then it's virtually impossible to get any kind of a diver or equipment down there. So that some of the research is being developed now to have some sort of surveillance for determining where your scour holes are during high water, because at the time the scour subsides—and that's why we didn't push too much on looking after floods because in a scourable stream, the riverbeds usually reside and the finds fill in the scour holes and then there is virtually nothing to see.

Mr. **Oberstar**. That is very true. Again, weather phenomena have some cyclical aspect to their appearances, and inspection just prior to the hurricane season and prior to the onset of winter are appropriate times, it seems, for such inspections, far preferable than risking someone's life to go out there when the currents are raging.

In the past, the National Transportation Safety Board has pointed out the lack of specific Federal Highway Administration guidance on when how to perform underwater inspection of bridges.

Are you planning to issue criteria for the states on frequency, quality, and scope of underwater inspection?

Mr. MORGAN. I believe we will actually get to that point. It's incremental. We do have guidance out now, as Mr. Gordon pointed out earlier. We are developing further guidance on the scour-susceptible structures, and as it becomes available it will be distributed.

Now, as we discussed a little earlier about perhaps some standards or criteria for the actual underwater inspector, I think it is worth looking into. Whether we will ever have broad standards or a narrow set of standards—"thou shalt's" right down the line for underwater inspection—I am not willing to commit to that. I rather doubt it. The National Transportation Safety Board would have us do that in this and other areas. I am a firm believer that there is a place for standards. There is also a place for the professionals who are really responsible for it and they should be encouraged to develop their own standards of conduct and care—and I am talking about the States and local bridge owners—rather than impose prescriptive Federal standards.

Mr. OBERSTAR. You are referring to that area you described earlier as professional trust?

Mr. MORGAN. Yes, sir.

Mr. OBERSTAR. All right.

Mr. MORGAN. And the trust is not blind, Mr. Oberstar.

Mr. OBERSTAR. I understand that. I understand that, and I think it's very important to have an openness and flow of information.

In fact, in hearings we had on aircraft maintenance, airline mechanics said, "You know, something has happened in this whole process. We used to be able to sit down with the FAA inspectors and say, 'Now, look, here is something that is being done. This practice ought to be changed; it's not tough enough.' Or, 'This one is too demanding and ought to be changed this way.' And we don't do that anymore. In fact, we don't even see these people."

Now, the era of professional trust is very important, but on top of that professional trust is an overlay of specific, spelled-out responsibility.

Mr. MORGAN. Absolutely. I fully agree with that.

Mr. OBERSTAR. It doesn't hurt to have at least some general guidance so that you have a leash on the folks by which to measure their performance.

Mr. MORGAN. But the answer to all our problems, whether it's bridges or aircraft or anything, isn't necessarily developing rigid standards. The answer is how the actual inspection or program or whatever is carried out. I would much rather spend our professional efforts on working with the States to develop a sound program and then seeing that the program actually works, as opposed to having a large set of standards that are no more than paper.

As has been mentioned yesterday—I read some of the testimony—you can check off blocks and look great, but the proof is you're not great.

Mr. **Oberstar**. Well, that's quite right, and frequency of inspection may not be as important as the quality of that inspection, as to its extent and detail.

Mr. **Morgan**. Exactly. Exactly.

Mr. **Oberstar**. How do you measure that?

Mr. **Morgan**. How do I measure?

Mr. **Oberstar**. How are you measuring quality of inspection as separated from frequency of inspection?

Mr. **Morgan**. With our bridge engineers in the field accompanying the State and reviewing their actual activities, or, if the State uses a consultant, the consultant. Now, he doesn't go on every one. In fact, he goes on a very small percentage. But by spotchecking around, he can get a feel if they are quality inspections.

Mr. **Oberstar**. Well, that professional judgment is your yardstick then, for measuring?

Mr. **Morgan**. Well, no, sir, we have criteria. In other words, if somebody goes out on a very comprehensive structure, if they—for instance, one that's close by—went out on the Chesapeake Bay bridge and finished an inspection in two hours, I'd know that was a pencil-whipped inspection. You don't have to be any rocket scientist to figure that out. [Laughter.]

Mr. **Oberstar**. Do you get reports from your Federal inspectors that are critical of state operations?

Mr. **Morgan**. Yes, sir. Yes, sir.

Mr. **Oberstar**. You see, I worry about——

Mr. **Morgan**. Would you like to see some? [Laughter.]

Mr. **Oberstar**. Yes, I sure would. On the one hand we want that professional relationship, because I think a good deal can be accomplished. I really, truly have seen that, I believe. But I also think that it works best when that federal inspector is operating under a directive.

Mr. **Morgan**. Yes, sir.

Mr. **Oberstar**. That is a rulemaking, federal law, and he says, "I've got to do this."

Mr. **Morgan**. Sometimes a memo from the Executive Director will have the same results from our own people if we tell them what's expected of them. Our people are not completely reliant on regulation. Our Administrator, myself, there is a line going down to the field offices, and if we issue a policy or instruction, it will be followed.

Mr. **Oberstar**. The safety board asked the Federal Highway Administration to conduct research on this matter of frequency, what would be the appropriate level of frequency of inspection. Has any such study been done?

Mr. **Morgan**. No, sir. And I am not sure that's researchable. I wouldn't commit to any research on that. I think it's a question of looking at the inventories, the inspections we have, and looking at the history. I don't know if additional research would be beneficial in that area. None has been undertaken, and none is intended at this point in time.

Mr. **Oberstar**. Are standards set for the State inspectors? How are standards established, and who sets them?

Mr. MORGAN. The regulation, the prior one and the proposed one, do set standards for the one in overall charge of the program and for the team leaders.

Does it go deeper than that, Mr. Gordon?

Mr. GORDON. Oh, yes. Well, we have three requirements for a team leader who is heading up the entire program and a set of requirements. Now, as a result of the last highway Act, we are going to require certification where appropriate. This exam has some questions that some of our structural engineers would be hard-pressed to pass.

Mr. OBERSTAR. We have received testimony, but we didn't need the testimony to call the subcommittee's attention to the increasing number of trucks on the highway in the era of deregulation and the increasing weight of those vehicles. Of course, the Federal Highway Act of 1987 addresses the concern about the impact of trucks on bridges in the directed study on the bridge formula.

What thinking have you done on this? I am just throwing it out for you and want to get your reaction to concerns about the impact of trucks on bridges. Some testimony yesterday indicated that maybe we need not be too concerned about the impact on bridges, but more concerned about road surfaces, that trucks have a greater impact on road surface than on bridges that are built with a great deal of redundancy. I continue to be concerned about the impact of increased frequency of truck travel, increased weight on those bridges.

Mr. MORGAN. I, too. I share your concern. And whether it's pavement or bridges, it's part of the system, and certain configurations of trucks are harder on bridges, certain others are harder on pavements. But by and large, they are out there, and they can be from service-life standpoint, the determining factor, the number of trucks and the axle weights.

There is a change in our truck fleet, in our fleet mix, as you pointed out. There are more of them, and we are experiencing heavier loads. In the rural areas there is especially cause for concern because the trucks have taken over a lot of the railroad duties. So we see the heavier trucks on the rural roads, and they're going over bridges that just weren't designed for them. That is where we talked earlier of posting, and the economics of an area really are impacted by whether a truck goes in or out and whether a farmer gets his crop out or not.

So, there is an issue in the rural areas on trucks. I think a real issue that is one that's often overlooked is where they are taking over the role of the railroad for the haul to market, in essence. In the rest of the country and the system as whole, I do not believe we have much residual structural strength in the system. I believe we have to start monitoring our heavy truck routes, looking at those bridges, perhaps more frequently than we used to, especially those that were designed 30-40 years ago that actually have no residual structural strength in them. Of course, some of them do. Some of them have quite a bit of residual structural strength.

Mr. OBERSTAR. Well, I am glad to hear you say that, and I would hope that the Federal Highway Administration will initiate that kind of a systematic review and data collection and build a base of information.

Also, with respect to new bridge design, to build into new bridges the necessary margin of safety to accommodate this increasing truck traffic. I don't see it diminishing.

Mr. MORGAN. No, sir.

Mr. OBERSTAR. I don't see the railroads increasing their capacity to haul. I mean, if you got something, it came by truck.

Mr. MORGAN. That's right. If you got it, it came by truck. They are becoming the Nation's warehouse, too.

Mr. OBERSTAR. That's right.

Mr. MORGAN. It goes from port virtually to market without a stop in between. We are looking at a future highway program, and the issue that keeps coming back, in many respects, geometry, structural safety, is the trucks. All projections indicate an increase. There is a pressure for increasing length, size, to make it a more economical operation, and we have to really look at what we have out there and what we're building for the future to accommodate them. They are here to stay. They are not an enemy. They have to be accommodated, and I think we have to do it.

Mr. OBERSTAR. Yes.

Mr. MORGAN. Now, the biggest weakness, we know less about trucks than virtually anything else, and that's unusual. What is running on the roads, what are the weights? What we have been pushing for the last several years and are going to continue to push is an effective weigh-in-motion system, so the States and we know what's running. It is a weight system in the pavement where you can measure the trucks going over it, not at the weigh station, because they know how to get around those weigh stations.

But, in effect, you in your home State, Mr. Oberstar, have a demonstration going on, a low-cost weigh-in-motion system, that has been quite successful so far. That is really what we're looking for. Really, we talked about it earlier. You really have to know what's going over that bridge, what load is actually going over, not what the regulated load is or what they say they are, but what's actually on those axles of the truck, in order to be able to protect the structure.

Mr. OBERSTAR. Well, I think, as you pointed out, in these two areas we can identify those bridges that have a very high degree of truck impact simply because of the economic routes that they're following, and, two, the rural areas where discontinuance of rail service has increased the pressure on structures that weren't intended to carry the frequency and the weight of the truck traffic.

Mr. MORGAN. That's right.

Mr. OBERSTAR. We will be following that matter further.

Two final questions: How will the large number of bridges built in the 1950's and 1960's affect the rate of increase in deficient bridges over the next decade?

Mr. MORGAN. I am afraid that because of that bridge-building boom you mentioned, that we are going to see the number of deficient bridges increase after the next 10 years. I see it staying about the same over the next 10, but after that, increasing.

Approximately 40 percent of the total deck area of bridges is between 15 and 35 years old, and as that cohort, if you will, moves on, becomes older, it's obviously going to increase our problem. The solution to the problem, of course, is an effective bridge program. I am not going to say it's going to take more money. This bridge management concept I was talking about earlier, is where you aim your money and get at that bridge before it becomes a failure situation where you need a replacement as opposed to just maintenance.

Mr. OBERSTAR. You envision, then if I can summarize, an increase in the number of deficiencies over the tail end of the next decade.

Mr. MORGAN. Yes, sir.

Mr. OBERSTAR. And you also envision increasing or intensifying the inspection program in anticipation of that problem.

Mr. MORGAN. Absolutely.

Mr. OBERSTAR. Well, that's the kind of foresight that we are looking for, and we now need to begin that process of strengthening the bridge inspection program even further.

One final question on bridge design. Are there specific bridge designs that just simply shouldn't be allowed? And how do you weed those out?

Mr. GORDON. There are some bridge designs that have historically given us more problems than others. There are some of the new designs which we don't have much of a history on yet, and hopefully we won't have any problems. We are doing everything in our power to control the specifications so that we won't have problems.

But, yes, there are certain type of bridges that we discourage. The tied-arch, for example, the tied-arch structure doesn't have a high degree of redundancy. The failure of one tension member may in fact cause a catastrophic failure. It's a very popular structure because of its esthetics, and you can usually build them at low cost. But we do discourage it.

So, in answer to your question, Mr. Oberstar, yes.

Mr. MORGAN. Mr. Oberstar, one of my concerns in what we're looking at is our ability to design has outstripped our ability to construct. The designs that are on the boards with the thin sections, where the material and the construction methods are extremely critical. We're not building watches out there, we're building bridges, and that is where some of our concerns do come in on the designs. We are really looking at some of the newer designs and making sure that we do have enough section, so to speak, with redundancy in it that we're not asking too much of the industry that they can't build them.

Mr. OBERSTAR. I am glad to hear you say that, and I want to urge the Administration to continue its surveillance over bridge design and construction, beyond the state of the construction capacity, to include the design of bridges that may cause real problems in the future.

Mrs. BENTLEY. Mr. Chairman.

Mr. OBERSTAR. Yes, Ms. Bentley?

Mrs. BENTLEY. I would like to ask a question on that.

Mr. OBERSTAR. Certainly.

Mrs. BENTLEY. I have always looked with awe at bridges. You know, I have always wondered how people design them so that they can withstand the kind of traffic they do these days, so the statement you just made frightens me a little bit. I think our engineers of the past deserve all kinds of gold medals for what they've done.

Is part of the problem today the result of the failure to attract students into engineering schools, into technical schools, that the majority are going for MBA's and that type of thing? Is that part of our problem when you tell me that modern designs are questionable?

Mr. **Morgan**. That is part of the problem in the whole civil engineering field, with the highway engineering especially, Ms. Bentley. It's the fact that a lot of the highly technical students in the university now would rather go the computer route or get to the moon and the others would rather go MBA and make a million on Wall Street—and they're doing it. We have a shortage of people going into the transportation industry and the highway industry.

Now, there is a shortage today, and it will continue in the future, and I really don't have a solution. We're going to have to do a better selling job—when I say we, I'm talking about the professionals that are in the field right now—than we have in the past.

Mrs. **Bentley**. Mr. Chairman this illustrates what I have been hearing from my industrialists and business types, that our educational system is not encouraging young people to go into civil engineering and fields like that. They are urging them all to go into banking or finance or something in that area, and we are losing technical skills that we need. This is something that we in the Congress need to think about.

Mr. **Oberstar**. It is a matter of very real concern. The gentlelady raises a very important point, and I appreciate that.

Mrs. **Bentley**. Thank you.

Mr. **Oberstar**. Gentlemen, thank you very much for your presentation today. I want to point out that this is only the first in a series of inquiries we will be conducting into the Nation's bridge program. We started with bridge inspection. We will continue in that field. We will be looking into other aspects as well later on. We expect to see you again.

Mr. **Morgan**. Thank you, Mr. Chairman.

Mr. **Gordon**. Thank you.

Mr. **Oberstar**. Thank you very much.

[Mr. Morgan's prepared statement follows:]

STATEMENT OF R. D. MORGAN
Executive Director
Federal Highway Administration

HEARING BEFORE THE SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT OF THE HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

BRIDGE INSPECTION AND BRIDGE SAFETY

December 2, 1987

Good morning, Mr. Chairman.

It is appropriate that we review the Nation's bridge inspection program as we near the 20th anniversary of the cataclysmic event which began it all. The December 15, 1967, catastrophic collapse of the Silver Bridge between West Virginia and Ohio resulted in the deaths of 46 people. After a series of extensive hearings and investigations concerning the Silver Bridge collapse, the Congress directed the U. S. Secretary of Transportation in the 1968 Federal-Aid Highway Act to develop national bridge inspection standards to apply to all bridges on the Federal-aid highway system. As a result of the 1970 Federal-Aid Highway Act, these National Bridge Inspection Standards (NBIS) were published in the Federal Register in April of 1971. The NBIS specified (1) inspection methods, (2) frequency of inspections, (3) qualifications of inspectors, (4) that inventory data be kept, and (5) that safe load capacity of bridges be determined for all 270,000 Federal-aid system bridges.

At the same time, the Federal Highway Administration (FHWA) with the assistance of the States and other interested and knowledgeable parties developed a 3-week long comprehensive training course for bridge inspectors, and a complete Bridge Inspector's Training Manual which was made available to all States. As the inspection program progressed, additional manuals, training courses, and inspection tools and procedures have been developed, and the Nation has developed a large cadre of experienced, trained bridge inspectors.

The 1978 Surface Transportation Assistance Act brought about an expansion of the NBIS to include all bridges on public roads. This greatly complicated the States' task by adding more than 300,000 bridges to NBIS coverage. It made the NBIS much more difficult to administer for both the FHWA and States because the majority of these 300,000 off-system bridges are under the jurisdiction of the more than 3,500 local governmental entities in the Nation. In order to inform local governments of the new requirements, the FHWA cooperated with the National Association of Counties and the National Association of County Engineers to hold a series of national workshops in each FHWA region to explain the program. A complete package of training materials and bridge inspection guidelines was also made available to all interested governmental officials.

More training courses were developed by the FHWA; one of the most successful was one entitled, "Practical Highway Bridge

Inspection for Local Jurisdiction Bridge Inspectors." It was presented about 24 times throughout the Nation and is still in demand.

All States and most local governments proceeded to implement the new off system provisions of the NBIS.

However, early in the 1980's, it became increasingly clear that some States were having significant difficulties convincing certain local jurisdictions that the frequency and load posting requirements of the NBIS must be strictly adhered to. As a result, the FHWA and the States continued strong efforts in a cooperatiove manner to assist and convince local governments that all provisions of the NBIS must be followed to ensure public safety.

In 1984, the FHWA conducted a comprehensive management review of the entire bridge program to determine compliance levels and the effectiveness of bridge improvement programs. As a result of the findings of the review and ongoing concerns about the apparent lack of interest of some local governments in NBIS compliance, a very strong FHWA policy statement was issued on May 14, 1985, which required that all jurisdictions not in compliance with the frequency and load posting requirements of the NBIS be directed that they must (1) immediately achieve compliance or (2) develop aggressive, short-term plans to correct NBIS deficiencies. Any jurisdiction not responding favorably within 90 days was to have further approvals of Federal-aid highway projects suspended until the governmental entity complied with the NBIS.

To date, Federal-aid highway project approvals have formally or informally been temporarily suspended in 456 jurisdictions. Most of these have been subsequently rescinded as the result of actions taken by the local governments to comply. However, there are still 144 suspensions in effect and more may be necessary should any governmental unit lapse into non-compliance with the NBIS.

Unfortunately, there have been two additional catastrophic collapses since the 1967 Silver Bridge disaster. The 1983 collapse of the I-95 Connecticut Turnpike Bridge and the 1987 collapse of the I-90 New York Thruway Bridge over Schoharie Creek, both of which were on toll facilities under the jurisdiction of toll authorities and not subject to direct State highway agency control, again focused national attention upon the bridge inspection program. The need to strengthen inspection efforts for fracture critical members and ensure adequate underwater inspection programs was accentuated by these two collapses.

Current Federal-aid procedures for new major bridge projects require that all fracture critical details be identified on project plans and that special maintenance and inspection manuals be prepared for major or unusual bridges.

In 1983 and 1984, the FHWA developed, through contractual procedures, two supplements to the Bridge Inspector's Training Manual, one for Inspection of Fracture Critical Members and one for Inspection of Culverts. Through the FHWA's National Highway Institute, companion training courses for these two new supplements have been made available for bridge inspectors throughout the Nation. They have been offered or scheduled at 36 and 24 locations respectively, and the FHWA is making provision to provide these training courses as many more times as State and local bridge inspectors request them.

Underwater inspection programs have been lacking in some jurisdictions because of the apparent perception that they were not needed, they are too costly or just too difficult for some agencies to carry out. In 1985 (two years before the Schoharie Creek collapse), the FHWA issued a firm policy statement which clearly reminded all bridge owners that appropriate underwater inspection programs must be included within overall programs to comply with the NBIS. In 1986, this policy was reinforced with an additional policy memorandum to field offices that the absence of underwater inspection programs should result in the same consequence as inspection frequency and load posting inadequacies. That is, noncomplying jurisdictions would be jeopardizing further approvals of Federal-aid highway projects.

As a result of cooperative efforts of American Association of State Highway and Transportation Officials, individual States, the Transportation Research Board, the FHWA and others, the States have fully implemented their underwater inspection programs for 85 percent of State maintained and 64 percent of locally maintained bridges. The remainder are being actively implemented.

Because bridge inspection technology is constantly changing and ongoing evaluations of the Nation's bridge inspection programs suggests a strong need for updating the NBIS, on April 7, 1987 the FHWA issued a notice of proposed rulemaking (NPRM) in the Federal Register to suggest appropriate improvements. The NPRM would permit States to (1) set an appropriate time interval between inspections for certain types or groups of bridges as opposed to the current 2-year maximum period between inspections, (2) require special identification, inspection procedures and follow-up for bridges with fracture critical members and for bridges which require underwater or other special inspections, (3) allow another qualification procedure for bridge inspection team leaders and (4) require reasonably prompt updating of State bridge inspection inventory data when the status of a bridge changes as the result of replacement, rehabilitation or load posting.

A total of 61 comments were received as the result of the NPRM. The FHWA has evaluated them and has drafted a final rule which is now under review. The draft changes, if adopted, will permit the States to better concentrate their inspection resources on those bridges which need the most inspection effort. Although the net result will be that the standard inspection frequency will still be 2 years, some bridges will be inspected more often and others, in very good condition without adverse ambient or structural problems, could be inspected less often.

In summary, the Nation's bridge inspection program has matured steadily since its inception. During a period of rapid growth in truck traffic, limited resources and aging bridges, the program is doing its job. States and local governments have forestalled bridge collapses, been able to cost-effectively rehabilitate bridges at the right time and have generally provided an unparalleled degree of bridge safety for the traveling public.

The FHWA will continue to work with bridge owners to bring about any needed changes to ensure the maximum degree of safety possible for our Nation's highway bridges.

Mr. **Oberstar**. There is a vote in progress on the House floor, we will recess until 1:00 p.m. and attempt to conclude our hearing with our next witness, Mr. Abba Lichtenstein.

[Whereupon, at 12:07 p.m., the subcommittee was recessed, to reconvene at 1:00 p.m., this same day.]

AFTERNOON SESSION—1:35 P.M.

Mr. **Oberstar**. The subcommittee will come to order, with apologies from the Chair for this inadvertent delay in returning. The vote took a little longer than expected, and a previous commitment took me longer than anticipated.

Mr. **Oberstar**. Our witness this afternoon is Mr. Abba G. Lichtenstein, who is a professional engineer in the private sector, head of his own engineering consulting firm.

Please raise your right hand. Do you solemnly swear the testimony you are about to give the subcommittee will be the truth, the whole truth, and nothing but the truth, so help you God?

Mr. **Lichtenstein**. I do.

Mr. **Oberstar**. Thank you.

Mr. Lichtenstein, we greatly appreciate your participation in the committee's hearing, and especially the time that you are taking from your own enterprise I am sure, at very great cost to yourself. This is time that you are not out earning a living, but you are making a very valuable public-service contribution to the cause of highway safety and bridge safety, and we greatly value the time and effort that you have put into the preparation for this hearing and the testimony you have submitted.

TESTIMONY OF ABBA G. LICHTENSTEIN, P.E., PRESIDENT, A.G. LICHTENSTEIN ASSOCIATES

Mr. **Lichtenstein**. Thank you, Mr. Oberstar, Mr. Clinger, ladies and gentlemen. Good afternoon. I have submitted a statement to staff a few days ago. I believe it is signed, and if you will accept it as my testimony, I would appreciate that. If not, I have an extra copy here.

Mr. **Oberstar**. The entire written document will appear in the record at this point, and we invite you to summarize as you wish to do.

Mr. **Lichtenstein**. I would like, however, to go over it with you, with your permission, and kind of highlight some of the points in there. As I was listening to Mr. Morgan's testimony this morning, I am sure you have a few questions on that pad, so we will leave some time for that.

I would, if you don't mind taking this with a grain of modesty—but I am under oath and I have to tell the truth—I have been in business for a long time, and I have been in the bridge design and inspection business for about 35 years. I founded my company 25 years ago, and that is about the time that we started to inspect and evaluate structures. That takes me about five years before the Silver Bridge decided to fall down. And we started with our own ideas, our own methods. There was no specific AASHTO requirements on how to do this work.

Since then, we have completed about 4,000 inspections—that's give or take 10 percent here or there. So, I feel that I come here with some hands-on knowledge of how to do it. I am not going to talk to you about philosophy, or very little. But I would like to talk to you about the real nuts and bolts of bridge inspection, safety, and the other items that are related to it.

One other point I would like to say is that I am also involved very deeply in teaching seminars and short and long courses in training inspectors. You have been talking about NICET regulations this morning. We have not specifically told these people who we teach for States and for other Governmental agencies that they are being trained to take an exam. That is not the idea. But the way our course was structured was with the advice of the NICET directors, so that if they were to decide they want to take an exam and become a certified bridge inspector, I think that would be quite well, and we have had some experience in the past that they did make the exam pretty well.

What I would like, however, to caution and that's something that we should underline, these people are not supposed to do calculations. They are only inspectors, they know what they're looking at, they understand what tension and compression is, but that's as far as they will go.

So, in the document that is being proposed by the Federal Highway, I think we ought to make absolutely sure that while we accept these people as bona fide and good bridge inspectors, they are not bridge design calculators, nor should they be doing this work without the supervision of a professional bridge engineer.

I would like to add in passing that in all these courses that we been dealing with in many, many States, that we always receive a lot of help from the Federal Highway Administration. You like to hear that. We get their booklets, most of the time free. We get speakers that come in from the Federal Highway and speak to the class on specific items. We appreciate that. And I am sure the funding comes from the Federal Highway, or the training people would not be so anxious and so willing to continuously run these courses year after year and turn out 30 to 40 bona fide bridge inspectors that work for the States. And they are all technicians, most of the time.

So, with that beginning, I would like to go over and reply to some of the questions that have been raised to me. One of the main points that I see here, we discussed qualification of inspectors. You have discussed frequency. You have discussed many items. But you have not discussed one main definition: what is a bridge inspection? I think you hinted on that in your question about quality. But I don't think that's exactly what I had in mind. I would like to know what you expect from a bridge inspection. What kind of inspection? I have been talking about that now for the last 10 years. I have been attending AASHTO meetings. I talked to Mr. Roberts, who was here yesterday, and I have now become almost a nuisance on his committee, but he does invite me to attend, and I am not a bridge engineer representing a State. And I believe AASHTO is now coming to a point where they are going to define what is an inspection.

For instance, if I get in a convertible and drive through a bridge with the binoculars, I don't think you'd accept that as an inspection. Right, Mr. Oberstar? This would be a waste of time. But it's an inspection. If I have to fill out a form that I've seen the bridge, that's done. So, just talking about frequency without telling me what I am going to have to do to earn that frequency is only half the story.

Therefore, we consider that every bridge should have an initial in-depth inspection. And that means soup to nuts, the whole works. You've got to look at it. You've got to check all the details, and the bridge could be new or it could be old. As long as it has not been inspected in detail, then I would not accept that as the first baseline. From that point on, we can talk about anything you wish, but you've got to give me first the opportunity to inspect that bridge in depth.

So, we're talking about something that may be called an inventory initial inspection. Once we pass that point, okay, now we have identified the various points, the various problems that maybe this bridge has, for instance, that it may be corroded in a member and one member controls the rating and you have to post because one member is bad. That member should either be repaired or, if not, that member should be inspected not every two years, maybe every six months.

But the second inspection does not have to be in such a severity, does not have to be of such an intensity, doesn't have to be as expensive as the first one. And I say to you, "Okay, let's set a limit, three years four years for that second inspection." In the meantime, we are going to look at these details that you mentioned today—nonredundancy, the pin and hangers, underwater inspections—things like that which have to be done and we all recognize it.

But the big bulk of our bridges—all these rolled beams, what I call simple stringer bridges, we build thousands of them in the interstate program and in the highway departments—they could be definitely on the second time around; they could have a much less intense inspection with only concentrating on the areas that the first in-depth inspection has told them to. There is a point where you have to go in and look at it. You have to check the assembly, the pin and hangers. You've got to look at the fracture-critical details, things to that effect.

Now, I also think that every maybe 12 years, if we use four, we should go and have another in-depth inspection, we shouldn't just forget. So that at that point we evaluate that the next cycle may be 12 years or it may be 10 years, it may be eight years. Let's see how the bridges perform.

We're talking about a bridge in New York City that gets 150,000 vehicles a day and we talk of a bridge in the rural area that takes 750 vehicles a day, and I think we've got to make a judgment somewhere along the line here if we're going to have the same number and same intensity of inspection.

So, I think there is lots to be done, and I look at this proposed revisions by the Federal Highway as a good time to get this issue of the inspection described, defined, and get some kind of a cyclical inspection period, so that we don't completely depend on the bridge just to look at it every four years, if you will, but also every 12 years have another in-depth inspection.

The other point that I wanted to make, and I think it was mentioned before, that reinforced concrete culverts, box culverts, maybe some simple bridges, nonredundant structures, I see no problem. I think we probably could look at them very easily every four years without any increase in the risk to the public at all. We have looked at these bridges every two years, and the reports look identical in some of these.

I feel that with that money—and I know Mr. Morgan testified there won't any savings—I think there will be savings. Maybe it's not much, but that money should go into the repair of the bridges so that we can get rid of some of these posted bridges and put them to sleep so that the ones that are simple to get rid of, let's do it. If the bridge has to be widened 10 feet to make it, maybe that's a big problem. But if two members have to have—if cover plates have to be added or a shoe has to be repaired or we have to put some sheet piling around a pier to make it stable, that's the kind of things which we can do easily and use that money and then get one bridge off. That would be one less bridge to worry about, and then continue our inspection with the four-year cycle.

On the other hand, if we have these metal, corrugated metal arch bridges which depend on shape, by no means would I like to have that period extended. I have seen where a very simple 30-foot span killed five people, without any provocation at all, and that only depends on the shape. So, I think those should be kept at the two-year maximum, if not even more often.

So, we already discussed the fatigue and all the other things.

Now, talking about the underwater, you have mentioned how the five-year came about. I think that was a good point. I think it is important to inspect them after natural occurrences, floods, high-water marks, obviously earthquakes and things to that effect. I think that that's very important because while it's true that the silt does come back and the hole fills in, still if you get an experienced diver down there, he can feel by the consistency of the material that there has been a movement. This big energy that the storm has picked on is the very thing that's light underneath the bridge and takes it away, and then when the flood recedes, why, sand is brought back in again. I call it sand because that's basically what's traveling, little pebbles.

But there is a way, I think, to determine if there has been a scour problem there or not. So, let's not throw away the—after every major natural disaster or flood, that that is a given. Then I can bargain with you whether it's five years or four years because I think the four years appeals to me since the Federal Highway Administration uses that logic in their memorandum. They feel it would be easy. I think we ought to put that—it's cheaper—less expensive is a better word—to have the inspections done at the same time.

Looking from a consultant's point of view, we have a project man, we have people organized, we have mobilized. If we can do the underwater inspection on some kind of cycle rather than to have to send them out completely all by itself, I think it would be more economical to the States to have some kind of a cycle of, let's say, four years. I am using that. It's not an important issue, but I thought I would make a comment on that.

Now, there was a question about posting of bridges. Because we post bridges now based on the operating rating and that is coming from the national bridge inspection. Maybe I should explain it to you. There are two levels for rating a bridge. There is the inventory rating and the operating rating. The inventory is the performance of the bridge on a daily basis. The operating is an occasional. If you have a bridge next to a fire house and it has to be overloaded five times a year that would be a reasonable number of fires you'd expect, or if you have a big nuclear furnace traveling on your highways, it can stand a slight overstress. So that you get a bigger load capacity for the occasional load than you would get for the daily load.

Right now, the limit is set at 15 tons on the operating ratings. I feel that requires some looking into, and I don't know if the Federal Highway is willing to look into this point. But I am very conservative in the idea. I feel this factor of safety that the chairman was talking about with the bigger trucks, it's good to have something in back there, and if we do have a bigger factor of safety, I am all for it. I don't want to change my calculations to accommodate a daily load. I don't mind doing this on an occasional basis if I have to pass a bigger truck.

So, as far as posting, we know another danger that he can't enforce it. There is no way we can enforce posting. You can put your scales out there and on the CB everybody knows that you've got the police at Washington Street and they're all going to go on Jefferson Street. So we can't really police it. And I have seen bridges that have been inspected maybe twice in six years, they collapsed because of an overloaded truck. Fortunately, the people that came back an hour and a half later didn't get hurt too badly. They had seat belts on. But that is the kind of thing that you do have.

And so the best thing to do with posting is get rid of the posted bridges if you can, or at least put them into some kind of a program where you can eliminate the easy ones and work a little bit harder on the other ones.

Now, I had a few other points here. You asked about new technology and things to that effect. I think they are some tools which are coming up. I don't know. We believe in this very personal approach of hands on. We look at the bridge, we get a feel of what it does, make calculations. To put some kind of an instrument on a bridge that will blow a whistle when you are five minutes away from collapse, I don't think that's really ready yet. It may be part of the Star Wars, I don't know. But that's something that we don't know much about.

But we do have certain instruments that we are acquainted with. I see this on my committee for ASTM where we discuss thermographic and radar, and I am sure all the States use it slowly but surely. But we are getting a lot of decks inspected in very good order, faster than we used to, and we get them replaced and repaired.

Also, there is a lot of research being done. Now, this fatigue business, as you indicated this morning, is something that bothers us all. I think this weigh-in-motion idea that Dr. Moses has developed at Case Western Reserve, we have helped him in writing two papers, one on determining the fatigue life of a bridge and one to determine the capacity of a bridge—in other words, what's the bridge good for as of a given moment. That, too, is before AASHTO now with transportation research board money backing it. And you know AASHTO has to have 50 approvals, and it will take time, but I think we're going to get there, where we will have better ways of evaluating the fatigue capacity of these bridges that have these fatigue problems.

Now, you also asked something about Federal agencies, are they complying. Yes, I find they are complying with the inspection. I mentioned that in my course here at George Washington University. I teach a refresher course, three days on bridge inspection, including underwater. We had eight people representing the Corps of Engineers from five States. It's too bad Mrs. Johnson isn't here. I was going to congratulate her. We had three people from Connecticut DOT. They show up every six months. We give this course every six months.

So it is—and I know, for instance, NASA, which is also a Federal agency, they have four bridges in Cape Canaveral, movable bridges, and we've inspected them for them in connection with AASHTO and Florida requirements. So, they are complying, as best as I can tell, and I am sure Mr. Morgan has a better handle on this this morning.

You also asked me to discuss the collapses of the Schoharie Creek and Mianus River. Well, I am familiar with those two structures, I must say. Every bridge engineer would be. And I have been close to it, but I am in sworn testimony here and I don't think I could give you much help from what I've read in the newspapers. So we will have to put those two bridges—maybe I can answer some mild questions.

One the other hand, I spent eight years investigating the collapse of the Silver Bridge. And contrary to what everybody tells you, that did not collapse because of poor inspection. It collapsed simply because one detail in there was not designed properly and the factor of safety was reduced in the chain—it had a big chain, like a bicycle chain—that supported the bridge, and one item in there was to reduce the factor of safety substantially to save money. That's how they got the job.

In 41 years that the bridge was existing, nobody checked the capacity of that as would be against the actual specifications. This is what I am talking about: an in-depth inspection means you go back to the calculations and you check to see what the bridge is worth at the time you make the inspection. This is what an in-depth inspection is.

Even when the bridge changed hands, there was no calculations made. And I feel that's bad. I think that's something else AASHTO should have, where if one jurisdiction takes over a bridge from another, let's say, from a State to—or from a county to a State or from a city to a county. I think there should be an in-depth inspection made so that you don't buy your bus just by kicking the tires. That's a school bus, and you've got to know everything before you buy that bus.

The next point here is about the structures, what I call young structures, 30 to 40 years old. I don't think you're going to have too much trouble with them. I was glad to hear Mr. Morgan predicts maybe 10 years from now. I would kind of go along with him. We know these bridges. We know all these details that should have been known. They've been inspected quite a number of times. All the bad details—let's take the pin and hangers, again Mrs. Johnson would be pleased we have 34 bridges in Connecticut that have pin and hangers in them, and they are now being redesigned, each one of them in one form or another.

In Pennsylvania we checked about 20 of these bridges in 1984—or is it 1983—I think maybe it was 1983. And we found one bridge that required immediate attention. The others were put on the strengthening list. One in New York also we found which was in that not good condition; there was movement in the pins and should have been replaced.

But otherwise, I think, you should not have too much trouble with these 30-to-40-year-old bridges immediately.

The area which you will have is the area of prestressed concrete. We do not have a good tool to look inside of these prestressed concrete bridges and determine whether the cables and the wires and the wires inside, what shape they're in, whether they corroded. I don't know of any. We keep guessing at them. We keep looking at them. Certainly, those bridges should not be placed on any four-year schedule, they should be two years or less, because the first sign we will get is when something starts happening. So, we should have a lot of warning on these prestressed concrete structures.

Now, also we were talking about this balancing of funding: how much money should go into preventive maintenance, how much should go into repair, how much for replacement.

Mr. Clinger's State was fortunate to start its bridge management early. They were the first State, I think. Secretary Larson asked me to participate in a task group, and we spent about nine months, a once-a-month meeting, about six or seven, looking through all the facets of bridge management, and we felt Pennsylvania would gain a lot from the implementation. And by now, they have the most sophisticated bridge management program, I think, in the country. I may be wrong in that. I may be also prejudiced. But they do have a good one.

Now, what appeals to me in that is that you can kind of with limited funding is really what we start out with—we don't have all the money in the world—that we could find out what would be the best way to protect the integrity of our bridges for each given Governmental agency or agency. In other words, if it's a county or the State in itself, and what type of bridges, they can run through it. And what they use is this information that we get for them in the field. It's information that I feel the in-depth and all the ones that you were talking about with Mr. Morgan, all these 70 or 80 numbers that they fill out on that sheet. I think Mr. Clinger was very interested in that.

So that goes in there. You know, Pennsylvania had a program about three years ago—or maybe five years ago, I'm sorry—where we were training local public works officials in how to maintain their bridges. It was implemented by Penn State. Dr. McClure and

I traveled the whole State. I have seen every Holiday Inn in the State of Pennsylvania, I want you to know that. And we had 20 or 30 people in each group, and we went through with them by slides and by action and showed them how they can maintain their bridges.

And, yes, it did come up, this problem that we don't want to paint the bridge and look underneath, we want to paint it maybe two weeks before election and never see what's on the bottom. That is really—that came up. But I think the punch line on there is if that bridge is going to collapse, you're not going to stay in office very long. So, there is a give-and-take.

And the State was very helpful. I think the State of Pennsylvania is very cognizant of these problems. They have a very wide State, and we did speak to many of those people, and I think they were appreciative, and we did have a lot of good questions and answers on that.

Now that I am giving you a compliment, let's see if we can help ourselves. You were discussing the problem of maintenance, how that is not a Federally funded item. Preventive maintenance and repair. We get into rehabilitation, I think we are entitled to some Federal funding. I think we have got to come up with something before 1991 to help these smaller entities. One idea I thought I had is, if let's assume that a county has 200 bridges and they spend some money on maintenance of the bridges they can, then I think they should qualify, they should go up to the top of the list for Federal aid on the million-dollar jobs that they need.

In other words, though you're not going to give them some financial assistance, you ought to give them some moral assistance, push them up in the line of getting assistance when they need it. Let's say after $100,000 repairs, they can do themselves. We get into the higher, half a million and up, they should come to the Federal Government and ask for assistance.

Now, you noted if you have all your counties do that, I see that the counties that have done their work and have spent money, they should be in the forefront in getting Federal assistance. It may be a pie-in-the-sky type of an idea, but I thought it's worth investigating. From the questions you were asking this morning, I felt that any new idea, even though it may be all wet, could still get some consideration.

Now, the last item I wanted to touch on was historic bridges. That is a subject that's very close to my heart. I would be remiss if I did not congratulate you on including the historic bridges into your last 1987 act. I think it's very important for the country to know that Congress stands behind them when they want to go out and rehabilitate and retain a structure that has some heritage in it. I as one bridge engineer that does a lot of restoration work feels that this encouragement we got plus the possibility of getting some funding in lieu of demolition of a structure, getting to repair it is a good idea forward. From my travels, I think you get a lot of kudos from the people who vote for you.

I think that basically completes my testimony. I would say I was honored to be here. I really feel that it is really an honor to be, and to be able to share with you my thoughts on this matter. If I can be of any little help, why, I feel my day has been justified, and don't worry about dollars. Okay.

Mr. **Oberstar**. Well, we would like to have State and local highway officials take the same attitude. Let's not worry first about dollars and cents, let's worry first about safety and then fit the dollars into the safety consideration.

Thank you very, very much for thorough, objective look at the issues the subcommittee presented to you and for sharing with us your wealth of experience and wisdom in the fields of bridge safety and bridge inspection.

You raised a very important first-line question, when you said, we should be asking what constitutes an inspection. We have sort of taken that matter for granted, that we do understand the elements that go into an inspection. We have never really raised that question with the Federal Highway Administration, to kind of think through, as I in retrospect think we should have, their philosophy of bridge inspection and what constitutes good bridge inspection.

So, let's start with that. What constitutes a good inspection of bridges?

Mr. **Lichtenstein**. Well, the idea is to design the bridge in reverse. That's what I really look at. You design the bridge in reverse. You have a bridge there, you've got to establish its load-carrying capacity. In order to do that, you've got know everything about that structure: You've got to know the measurements. You've got to know the details. You've got to know the quality of the materials—is it steel, is it wrought iron, is it concrete, what concrete. You've got to know its foundation capabilities. You've got to do calculations, and you've got to come up with a comprehensive report that tells you that on December 2, 1987, that's what the capacity of the bridge was because that's what we computed the best way we know how. ANd we have the same way we design bridges, we should be able to undesign them or design them in reverse.

Now, I would say that at the last AASHTO meeting in April, Mr. Roberts has indicated that AASHTO will, after much resistance over many years, prepare a definition for three or four types of inspections. And I have received a draft of that. They were kind enough to let me in on their work. And I definitely feel we're going in the right direction.

So, I expect maybe in a year or two AASHTO—the little yellow manual that somebody probably showed you yesterday—will have a definition for what an inspection is. And I think then we can have the in-depth inspection. Then the second one that I called routine inspection; that's the one that is lesser intensity but it's accompanied by a special inspection of the details in areas for that particular bridge has maladies or suffers from.

I don't know if I made myself clear.

Mr. **Oberstar**. Yes, yes. You certainly have, and that is very helpful. It's good to know that AASHTO is developing this definition to include in their manual.

Mr. **Lichtenstein**. Mr. Ahlskog has been very helpful on that committee as well and provided it with a lot of information. Mr. Ahlskog from the Federal Highway Administration.

Mr. **OBERSTAR**. Very good. Well, I think that's good, but it troubles me that the process within AASHTO is relatively closed, like a professional society talking to each other and not an open process, that you should have to say with great humility, "I felt very privileged to be invited to participate." It should be just the other way around: they should consider it a privilege to have someone like you and they should be inviting a whole lot of people into their process.

Mr. **LICHTENSTEIN**. They probably get it at home. They don't have to bring it to that one meeting at which they all meet where the rules and regulations are reviewed and updated. They have a lot of correspondence they get. But possibly some other people that have had problems with this type of inspection, with the lack of definition, have contacted them because once the thing got on the table, there was no objection. So the whole membership voted to let's go ahead and do that.

That will also help them in their legal problems, which is what I pointed out to them.

Mr. **OBERSTAR**. I gather from what you are saying that you are looking for a good deal more specificity in bridge inspection, a good deal more detail than the Federal Highway Administration seemed to be looking for in my questioning this morning. They seemed to be content with broad categorical descriptions, broad injunctions to States, and relying more upon the relationship, the professional relationship or professional trust, as Mr. Morgan put it, to carry out those details. I think what we are looking for is something a little more definitive in the rulemaking, that gives us a basis upon which the Congress and the Federal Highway Administration can measure progress on some quantifiable basis.

Mr. **LICHTENSTEIN**. Mr. Chairman, I think the definition belongs in AASHTO, not in the Federal Highway. I think that's where the bridge engineers and the city engineers and in fact the whole world uses AASHTO as a bridge design standard. And I think we've described everything else in that yellow manual, I think we ought to describe also what we're looking for. I think that's where that belongs.

As far as the Federal Highway, I believe they cross-reference everything to the AASHTO specifications anyway.

Mr. **OBERSTAR**. Does any—what is the word I want—does the question come up among States when they look at the AASHTO manual, does an engineer from New York have a different interpretation of what that manual says about a specific item such as load factor from, say, an engineer in Minnesota?

Mr. **LICHTENSTEIN**. They may have.

Mr. **OBERSTAR**. Differing interpretations of what it means?

Mr. **LICHTENSTEIN**. They may have as it relates to specific bridges they have under their jurisdiction. They may not have a cable stayed bridge in that State, and they don't really care. So, they may have—I don't know.

Mr. **OBERSTAR**. You see, what I am getting at is that in the FAA there are Federal air regulations (FAR) that apply to all the airlines, and in compliance with the FAR's, individual airlines must have a maintenance manual. That maintenance manual must then be reviewed and approved by the FAA, and it then becomes law for them to carry out.

But we found that there are differences among maintenance manuals, even though they're all governed by the same FAR's. There are discrepancies in how the FAR is interpreted. There are some things such as minimum maintenance standards and when questions raised as a result of such discrepancies, certain functions are not performed, and an accident results.

Mr. **Lichtenstein**. We work—most of our work is probably in about maybe a dozen States, maybe less. And each State—let's talk about design, which makes it easy also on the inspection and rating—each State in addition to AASHTO has a manual which they consider is their private and only applies to their State. Pennsylvania has a very explicit manual and detail manual, and also loading manual. They don't use the AASHTO loading per se; they have somewhat larger loadings. They have different factors.

So that the AASHTO is something that gives you a place to go from, you see. If you don't have that—I understand what you're telling me about the Federal Government, but I don't see it in the daily operations of a State or even my firm, where the Federal Highway gets involved at all. We are mostly involved with AASHTO and with the States we're working for both in the design and in the rating. And I think if AASHTO improved that one lack that we have discussed, I think it would help the whole profession.

Mr. **Oberstar**. You feel comfortable that there is a uniformity of application of that AASHTO manual among the several States?

Mr. **Lichtenstein**. Right. And then if Minnesota doesn't like that, they're going to go and issue what we have here, a technical something to their own people which the will also give to their consultants. I know I have been working on your Hennepin Avenue bridge, so I have been out there. I hope it still stands. [Laughter.]

Mr. **Oberstar**. At last look, I think one lane has been closed down on it, reserved for buses.

One final question. How do you conduct an evaluation of fatigue in a bridge? How do you measure that?

Mr. **Lichtenstein**. Well, that is a very good point. Most of our fatigue problems are relating to welding defects. In other words, if you have a steel bridge and it has a type of a weld on there which creates stress risers or the weld isn't proper or the material isn't right, it may create certain cracks at various temperatures. I won't go into all the details, et cetera, et cetera.

But there is a method that we see a bridge that looks like it could have potentially fatigue problems that we would spend some time looking into the details, testing them a little better, and make calculations. This is something that Dr. Moses has proposed for making it easier for everybody to establish the fatigue life, which in effect means the same thing: the condition of the bridge from a fatigue point of view.

Mr. **Oberstar**. Thank you very much.

Mr. Clinger?

Mr. **Clinger**. Thank you, Mr. Chairman.

And thank you, Mr. Lichtenstein, for some very interesting and helpful testimony.

Yesterday the Commission of the Connecticut DOT testified that no inspection would have discovered the design failure which caused the bridge disaster in Connecticut. I gather from what you are saying that you would disagree with that, that an inspection, from soup to nuts, at the beginning might have revealed the design failure before it led to the disaster that occurred.

Mr. LICHTENSTEIN. Why don't we talk about a bridge, let's say, in Pennsylvania that hasn't failed yet and you're asking me to go and inspect that bridge because of pin and hangers.

Mr. CLINGER. Right.

Mr. LICHTENSTEIN. I feel more comfortable talking to you in Harrisburg than in Hartford.

Mr. CLINGER. Okay. Fair enough. [Laughter.]

Mr. LICHTENSTEIN. Let's say if we were to do an in-depth inspection of that pin-and-hanger assembly, we would also have to do calculations. And if there was a mistake in the design or standards have changed or something has happened in that assembly, we should have picked it up.

The fact that we looked at it would give us the same idea, is the member in tension? It's an I-bar in tension. That immediately raises your ears, and it's a flagging. That's what we don't like, to have an I-bar—you know what an I-bar is, something that has a big hole in it and it has a pin in there. That's what the hanger basically is. If such, we would spend a lot of time looking into it making sure that it's in good design. That's about as close as I can give you of an answer on the pin and hanger.

Mr. CLINGER. Well, my sense is that a lot of the inspections that are presently done are really looking for defects in materials, rusting, cracks, fractures, scouring, et cetera, and not really giving the kind of attention to the basic design as it perhaps should receive.

Mr. LICHTENSTEIN. Well, you get rust, but you see, these joints, the I-bar, the hanger happen to be in an opening in the desk. Usually it's close by because there is movement there at the joint at that point. And there is water and salt and snow and ice and whatnot falls on there. So there is the potential of accumulating some corrosion in these members. And the rust is a very big force that pushes approximately 1,500 pounds per square inch. That's a lot of pressure. So, it wouldn't have hurt to take a look at and see what the condition of anything that happens to be on the open joint.

Mr. CLINGER. The gentleman from Connecticut also suggested that it might be a good idea to include a bridge safety expert in the design team. You have indicated that bridge safety experts have their place, but perhaps not as part of a design team. What you feel about that?

Mr. LICHTENSTEIN. I'm not sure I understand the concept, Mr. Clinger. Could you explain it to me?

Mr. CLINGER. Well, I guess what was being explained was that a lot of the problems that later develop into a bridge collapse or failure are attributable to design but that perhaps the pure bridge designer is not as sensitive to the safety concerns as somebody who specializes in looking only at safety factors.

Mr. LICHTENSTEIN. Well, I have heard a lot of suggestions made in the area of inspection to make it easy for bridges to be inspected, build the platforms, make sure that you can get to it, that you don't have to be an acrobat to see the detail without mirrors and all that. That's good thinking, but there again that falls more or less in the area of a good bridge designer.

The bridge safety, while I don't object to it, I think the guy has got to be able to design a bridge first before we can give him another heading as bridge safety. I don't think——

Mr. **Clinger**. Well, we have had some indication that, for example, in Germany, they include the very sorts of things you're talking about where they make it easy, in effect, to see the basic, important structures of the bridge without having to put yourself at risk to observe them.

Mr. **Lichtenstein**. Yes.

Mr. **Clinger**. And that sort of thing is not included very often in American bridge design.

Mr. **Lichtenstein**. No, but I would say the Federal Highway does not object, and that we have had this occasion, when you do want to put a platform on the bridge to make it easy to get your—and I don't think there has been any problem with getting it included in the normal contract if you do that. So, there is no Federal objections to providing accessibility for better inspection.

Again, getting back to the safety expert, I think whoever is going to rate or evaluate this bridge that was built 35 or 100 years ago should be a bridge engineer first. What else you want to do with him, I will defer to the commissioner from Connecticut.

Mr. **Clinger**. Now, you have indicated that you have served as a consultant to a number of State highway departments on bridges and also, I gather, as a contractor conducting bridge inspections and certifications?

Mr. **Lichtenstein**. Yes, sir.

Mr. **Clinger**. To your knowledge, is most of this work done by private consultants under contract, or is it done by State employees?

Mr. **Lichtenstein**. Well, you cannot receive a general answer to that. I think each State is doing its own thing. Mr. Morgan probably can give you a better inventory.

I will say this to you, that, for instance, in Tennessee, we trained their inspectors to inspect bridges, and the biggest contribution we made to them was we taught them how to do this uniformly. They have four districts, so a guy in District 1 sees a certain condition in a bridge and says it's a Number 4, and the other guy says it's a Number 6, and then they send the whole thing in to Nashville, where they have the evaluators who have never seen the bridge except for what they get from the field. So, we managed to get all these people together, and I think we improved their understanding. And I think they do all this themselves.

For instance, Massachusetts, I believe they do most of their bridges themselves except for the major bridges, and we have a contract that we inspect the larger bridges on a 24-hour notice. We have an office in Framingham, and they tell us, "Go and look at this bridge. The time of two years is up." Connecticut similarly.

So, I think it's a mixed bag, Mr. Clinger. But I find that the consultants that I have been dealing with in the meetings have by now learned AASHTO and have done a good job, and I think they have given the States their money's worth.

Mr. CLINGER. So, are you saying that there really isn't a tremendous disparity then between States and the quality of the inspections being conducted, whether by private sector or Government?

Mr. LICHTENSTEIN. I think if you're talking about the run-of-the-mill, the everyday bridges, no, there is no disparity.

If we talk about specialty jobs, I saw a representative here of the Port of New York Authority. We just did the outer bridge crossing. This was that bridge that took three months to inspect. Now, that would tie up their whole office and they couldn't do anything else, so it would be good to have, if you've got a rig, you've to put platforms, you've got to have special equipment and you've got to go underwater.

There are all these things we can do because we are trained to do it, and we take the problem away from them. In that case, then, I think the consultant could do a better job or maybe quicker and more economical, in my opinion, of course.

Mr. CLINGER. Right. [Laughter.]

A trifle biased there, but that's okay.

Mr. LICHTENSTEIN. He's listening. I wouldn't say that otherwise.

Mr. CLINGER. On the question of frequency of inspection, I think you have stressed something that seems to me to be self-evident, and that is that establishing arbitrary time frames for inspections is not as significant as recognizing the tremendous variety not only of types of bridges but also the conditions under which those bridges are used, volume of usage, weather conditions, frequency of flooding or heavy currents, that these are really the factors that should determine how often that bridge should be inspected.

Mr. LICHTENSTEIN. May I add, the redundant and nonredundant.

Mr. CLINGER. Right.

Mr. LICHTENSTEIN. Which raises a big flag immediately for us.

Mr. CLINGER. It seems to me that it's not very helpful to set arbitrary time periods because there is so much diversity.

Mr. LICHTENSTEIN. If I may just elaborate, Mr. Clinger, I believe that what the Federal Highway is proposing is that for each State that doesn't want to live with the two-year, to come back and say, "Okay, we've got seven bridges of pin and hangers, we've got 11 bridges with nonredundant; we've got these 100 with no piles on the foundation. Let us put those in a special category and inspect them X number of years."

Mr. CLINGER. That would make more sense.

Mr. LICHTENSTEIN. "And the rest of the thing we are going to see if we can do it on the three-year, the first year and maybe four-year the next time. And the money we save, we're going to take three bridges in group 1 and get rid of them and make them whole." I think that's what, even though it wasn't spelled out, but that would be the benefit I feel we would get from changing this.

Mr. CLINGER. Yes. Well, I think there was some indication at least from FHWA this morning that that was the kind of thing they were looking toward approving if States did come to them requesting changes. It would not be just five years or two years or whatever.

Mr. LICHTENSTEIN. Yes.

Mr. CLINGER. Frequency of inspection decisions would be made on a case by case basis depending on relevant conditions.

In conclusion, two years or so ago, I went up for the 100th anniversary of the Brooklyn Bridge. This bridge has survived up there in pretty good shape for over 100 years now. How come it's so darned good and we have so many problems with the bridges that have been constructed in the last 25 years?

Mr. LICHTENSTEIN. Well, it may cheer you up. There is a little town in Pennsylvania called Lackawaxen, and it's right on the Delaware River, and there is a bridge there that's 140 years old. That bridge was designed by Mr. Roebling, the same guy that designed the Brooklyn Bridge. In fact, I think he learned on the little bridge. It's a suspension bridge. And with Federal blessing, probably your money in it—Mr. McDade was the congressman—we're able to upgrade this bridge now to vehicular structure. It takes limited loads.

But the details that were used on that Lackawaxen bridge are almost identical in proportion to what is being used in the anchorage on the Brooklyn Bridge. There you have—I have tested those cables myself—they are wrought iron, dipped in hot, boiling linseed oil. And to this day they pull up to 102,000 p.s.i., which is 15 percent better than Mr. Roebling designed for, for the factor of safety and all.

So, I don't know, I didn't get a chance to answer Mrs. Bentley, but she was complaining that we are not as imaginative today in our designs as our forefathers were. And she's right. She's right. We don't have the cream of the crop of our engineering students do not go to civil engineering. I know. I am a member of several faculties, and I hear the complaining.

I think we've got to go back to high school—well, that's a different story.

Mr. CLINGER. Right.

Mr. LICHTENSTEIN. Where children start working on them.

Mr. CLINGER. Where is Mr. Roebling now that we need him?

Mr. LICHTENSTEIN. Yes. [Laughter.]

Mr. CLINGER. Thank you very much.

Thank you, Mr. Chairman.

Mr. OBERSTAR. Following up on that very important point, does that mean, and are you suggesting thereby, perhaps by inference, that Federal Highway Administration needs to pay closer attention to bridge design on new structures?

Mr. LICHTENSTEIN. Well, I think he indicated that they're not too happy with every design that comes across to them. I think you heard Mr. Gordon say that.

Mr. OBERSTAR. Yes. Mr. Morgan and Mr. Gordon both expressed concerns that maybe some of these new-fangled designs aren't as reliable as older, proven, and tested designs.

Mr. LICHTENSTEIN. Quite often I see a bridge that's 65 years old next to a bridge that's 10 years old, and I am not sure which one I like better from a structural point of view. So, it's a problem, yes.

Mr. OBERSTAR. Are you satisfied—you have done some training now of State inspectors—are you satisfied that inspectors are qualified generally or uniformly around the country and that the training programs are adequate?

Mr. LICHTENSTEIN. Well, some of the States are great sticklers. They have to pass this national bridge inspection course, which is, I think, a minimum of three weeks before they are allowed to go and inspect bridges. I think that is a good rule.

Some of them don't have a college education. Most of them don't. Some agencies that I worked with, these people are laborers, ironworkers, concrete mixers. In the wintertime when they don't have anything for them to do, they send them out as bridge inspectors. We don't like that. We don't feel that is really doing the job right.

Mr. OBERSTAR. Yes.

Mr. LICHTENSTEIN. So, we take these people and we give them an intensive course, including taking them out in the field, showing them how to set a ladder—it may sound simple, but there is a right way and a wrong way—and how to put a lanyard in, how to put the safety line in, all the things that we do. Then we give them an exam, and we feel at that point at least they will know if they see a crack whether it's just a railing falling apart or whether the bridge is falling apart. They will recognize it and they will be able to make the judgment.

I think most of the State inspectors at this stage today, 1987, are well equipped to do a good inspection.

Mr. OBERSTAR. Thank you. The safety board pointed out that bridges over water should be thoroughly inspected after a flood.

Mr. LICHTENSTEIN. Yes.

Mr. OBERSTAR. Do you feel that that is a reasonable recommendation?

Mr. LICHTENSTEIN. Yes.

Mr. OBERSTAR. Is it a practice being done by States where flooding occurs?

Mr. LICHTENSTEIN. Well, it's easier for me to answer the first question. I am wholeheartedly in agreement with that. I believe a bridge foundation should be inspected, particularly piers and abutments, right after each flood. There is no question in my mind.

As far as whether the States do it or not, I don't know. We've been invited by many counties to do that, smaller entities where they have had some damage: maybe one or two bridges collapsed and then they said go look at the other 70 bridges to make sure that they are safe. That we have done. But on the State level, I can't think right now.

Mr. OBERSTAR. All right. Finally, what do you feel about the five-year interval for bridge inspection of those structures that are over water?

Mr. LICHTENSTEIN. Have you granted me the fact that you are going to let me inspect it after major floods? Yes?

Mr. OBERSTAR. Yes.

Mr. LICHTENSTEIN. Let's assume that's already in that.

Mr. OBERSTAR. Yes.

Mr. LICHTENSTEIN. Okay. I have no big problem with the five years. I indicated that using the Federal Highway logic, it should be some multiple of two, so I thought possibly four would be closer to it. But I think five is good, from listening to—you know, we do inspect a lot of these bridges on the water. We have a complete team. In fact, we've got 380 bridges in Pennsylvania right now that we are looking at. I have two crews going through there, in this weather, but they are underwater.

They feel the five years is reasonable. I would say it's the maximum, in my opinion, maximum interval, as long as you give me that major storm. Okay? That I need.

Mr. **Oberstar**. I think that's essential.

Mr. Lichtenstein, thank you very, very much for the candor of your response, for the wealth of experience you bring to the subject of this hearing, and for taking the time to share both your experience and your knowledge and wisdom with us.

Mr. **Lichtenstein**. Well, thank you. I enjoyed talking to you.

[Mr. Lichtenstein's prepared statement follows:]

U. S. HOUSE OF REPRESENTATIVES

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT

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FOR

HEARING ON BRIDGE INSPECTION AND SAFETY

DECEMBER 2, 1987

A. G. LICHTENSTEIN & ASSOCIATES, INC.
CONSULTING ENGINEERS

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Bridges, Highways, Railroads
Hydraulic Studies & Dams

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November 25, 1987

Honorable James L. Oberstar, Chairman and
Honorable William F. Clinger, Jr., Ranking Republican Member
SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT
B376 Rayburn Building
Washington, D.C. 20515

RE: Hearings on Bridge Inspection
and Safety

Gentlemen:

We are honored to be asked to present our comments and testimony before your subcommittee on matters relating to the extant State of the Art of Bridge Inspection and Safety in the USA. Our Firm, founded by me twenty-five years ago, has continuously been involved in the inspection, evaluation, and rehabilitation of existing bridges of all types and sizes. We estimate that more than 4000 bridge evaluations have been completed by our personnel, having started this type of specialty engineering almost five years before the Silver Bridge collapse.

In addition, we have been active in the area of arranging and teaching short seminars on the evaluation of existing bridges, at various universities and public agencies. We recently expanded our educational activities to include the training of technicians for possible NICET certification as bridge inspectors, and also added a special course on underwater inspection of bridges.

In your letter of invitation, dated November 10, 1987, you requested that I provide testimony on certain specific issues; and my comments are presented in the same order as listed in the above noted letter:

1. "April 7, Rulemaking"

2. Frequency

3. Underwater Inspection

We transmitted our detailed comments to the FHWA by letter dated June 1, 1987 and attach a copy in full for your information. Highlighting our response were the following issues:

a. Before considering the frequency of bridge inspections we must define what constitutes a proper and adequate bridge inspection.

b. Every bridge must have an initial (or inventory) full in-depth inspection and evaluation, including calculating the load capacity and required testing.

c. Subsequent to the initial in-depth inspection, the bridge could be placed on an assigned frequency of Routine Inspections of lesser intensity than the initial effort. The scope of such a routine inspection would be a general field review of the bridge elements with particular attention given to specific areas and details as identified by the initial inspection report. For example, a load restricted bridge would require that the controlling members be scrutinized. In a pin and hanger structure, these critical assemblies would deserve special care. In welded bridges, fatigue sensitive details would be closely monitored.

d. The combination of an initial in-depth inspection and several follow-up routine inspections could be used to establish a customized inspection cycle for each bridge, with the intent of performing a new initial in-depth inspection every ten or twelve years. At that time, reevaluation of the inspection and maintenance cycle for this particular bridge can be undertaken.

e. Many bridges, such as newly constructed redundant structures and reinforced concrete box culverts; simple I beam bridges, could be adequately safeguarded for public use with an inspection frequency of four years.

f. The inspection interval should be kept at two years maximum for metal culverts which depend on shape; non-redundant-welded bridges; posted bridges; and other difficult access and pin connected trusses even when not posted.

g. Underwater inspection is proposed for all bridges over streams. While we have no objection to the five year frequency, it appears that a four year period may be more appropriate using the FHWA logic. However, a subaqueous inspection should be performed for many bridges after major storms, and special attention should be paid to steel and concrete piers in saline waters.

4. Current Levels &

5. Posting

While our assignments on bridge inspections are located in approximately a dozen states, we have had the opportunity to become acquainted with the programs of many other states and agencies through our seminars. We believe that these public agencies have been making a concerted, conscientious effort to inspect all bridges in accordance with the AASHTO Manual or State laws governing bridge safety. There is a great variation among the many State and other agencies as to the definition of an inspection, extent of rating calculations and testing. This discrepancy should be dispensed or lessened through the efforts of AASHTO and FHWA.

As to posting of inadequate bridges, the present Federal practice also needs to be revised since it only mandates the posting of signs if the bridge capacity is less than 15 tons (operating category). There is an understandable reluctance by the Bridge owners to Post "sick" bridges without clear and effective means of enforcing such load limits. This area of the bridge inspection strategy could be improved if some inspection funds saved from the spreading of the inspection cycles could be effectively applied to repair and rehabilitation of some posted bridges.

6. New Technology

The Transportation Research Board (TRB) and FHWA have been sponsoring studies and research into improved rating procedures for bridges. From our own experience, we participated in two projects under the auspices of Dr. Fred Moses of Case Western Reserve University, which could have a beneficial effect on the evaluation of specific structures:

a) Load Capacity Evaluation of Existing Bridges

b) Fatigue Evaluation Procedures for Steel Bridges.

We believe these and other similar programs are being discussed and implemented slowly through the normal AASHTO Bridge Committee procedures.

As chairman of ASTM Subcommittee D04.32 Bridges and Structures, I have become acquainted with some new tools and applications of old instruments, which can be used in inspection of certain components of bridges, such as thermographic and radar; ultrasonic and ACD probers, etc. These techniques are being utilized by the States under appropriate engineering and funding circumstances.

7. Federal Agencies

We have limited experience with Federally owned bridges. In the case of the Corps of Engineers, we noted an increase in COE engineers attending our refresher seminars in bridge inspection. For instance, recently at a course at George Washington University in Washington, D.C. out of 33 students, eight attendees represented the Corps from five states. Another example is NASA at Kennedy Space Center, which is complying with AASHTO and Florida Department of Transportation inspection requirements.

8. Collapses

It takes a series of unusual events and coincidences to collapse a bridge. Most of the time it is a combination of some design features and inspection procedures. Almost exactly twenty years ago, the

Silver Bridge collapsed carrying 46 people to their deaths. We were professionally involved in the legal disposition of this major tragedy and found that the designers reduced the factor of safety of the Eye-bar chain in an effort to save money. No inspection can detect this flaw, unless an in-depth load rating is performed. Such calculations were never made in the 41 years existence of the Silver bridge, not even when the ownership of the structure changed hands. As to the two specific instances mentioned in your letter, the Mianus River and the Schoharie Creek Bridges, we only know what we read in the press, and that is not enough to offer sworn testimony.

9. Bridges Built in 1950 & 1960

These 30 to 40 year old structures have been continuously inspected and, we hope, all their major defects have been detected and attended to. We see a great deck replacement initiative is underway in many States and toll roads. Welded steel bridges with fracture critical members or fatigue sensitive details should have been identified by now and closely monitored. "Pin and Hanger" designed bridges are being strengthened or retrofitted. In other words, it seems to me, that these "young" bridges have been well taken care of and thus I foresee no great impact on the national bridge inspection program.

One category, however, of "younger" structures which requires attention are the pre-stressed concrete deck slabs and I beams, and segmental post-tensioned bridges. We need new techniques and better instruments to establish the condition of the cables and wires imbedded inside the structures. Immediate research is indicated.

10. Bridge Programs Balance

The Departments of Transportation of many States have undertaken the creation of a Bridge Management Program, which program is being encouraged by the FHWA. I was fortunate to be appointed, by Secretary Larson, as a member of a TASK group in Pennsylvania to study the necessity and effectiveness of the Bridge Management concept. The task group found that such a program would be most beneficial to PENNDOT in the manner in which funds and projects could be assigned each year as the conditions surrounding the bridges change. The Bridge Management programs can project a maintenance schedule for any group of bridges, state or local, through which specific activities can be defined for any given interval. In such a way, inspections, preventive construction, repairs, rehabilitation and replacements can be specified. Of course, in smaller and more rural governmental entities, such programs can be produced by less sophisticated methods and common sense.

11. Historic Bridges

I would be remiss if I did not congratulate Congress for including a Chapter on Historic Bridges in the 1987 Surface Transportation Relocation Act. In my practice as a Bridge Engineer and restorer of Historic Bridges, the encouragement received from our elected officials is most welcome. I am certain that the number of deserving Historic Bridges thus saved and rehabilitated will increase as a direct result of this show of confidence from Congress.

In summary, the Subcommittee has undertaken an important and difficult task to learn the status of bridge inspections and improve the safety and confidence of the bridges as they serve the traveling public. I hope that my comments will assist the Subcommittee in their deliberations. I am grateful for the invitation to offer testimony.

Very truly yours,

A. G. LICHTENSTEIN & ASSOCIATES, INC.

A. G. Lichtenstein, P.E., Dr. Eng. (hc)

AGL:ig

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June 1, 1987

FHWA Docket N. 87-10
Federal Highway Administration
Room 4205 HCC-10
400 Seventh Street, S.W.
Washington, DC 20590

Re: 23 CFR Part 650
Requested Comments.

Gentlemen:

Thank you for sending us the Proposed Revisions to Subject Docket for review and comment. Our firm has been actively involved in the Inspection and Rating of Bridges for 25 years and is most interested in the State of the Art in this important facet of the operations of the Department of Transportation. In addition, we have been presenting Training and Refresher Courses at various Universities and Public agencies, on this subject of Bridge Inspection both to Engineers and Technicians.

We offer the following comments:

1. As I have been calling to your attention in the past, the NBIS does not define the intensity of an inspection. As late as last April, I brought this matter to the attention of the AASHTO Bridge Committee in San Diego, and I believe some progress in this regard may be expected.

2. The reason we need a definition of a Bridge Inspection is even more apparent when we consider the frequency of such and inspections. Are we talking about a casual, binocular type observation of a Bridge? Or an annual "Bond Holders" Inspection? Or an in-depth Inspection including material testing, load testing, calculations, etc...

3. We firmly believe that all Bridges must have an In-depth Inspection and Rating performed before the frequency is even discussed.

4. We have no argument with the suggestion that some Bridges-newly constructed, redundant designs, simple box culverts could be inspected every four years after the initial inspection.

5. On the other hand, the inspection interval should not be increased for culverts which depend on shape; non-redundant welded bridges; difficult access and detailed trusses and other similar complex structures, even when not posted. In fact, we believe, such structures should receive even closer scrutiny than two years.

6. Underwater inspection frequency is proposed for all structures. Using your suggestion on the four year interval (two times two years), possibly a four year interval would be more convenient. Certainly, most bridges should be inspected subaqueously after each major storm. Attention should be paid to steel structures in saline waters.

7. We believe it is beneficial to the Bridge Engineering Praterity to encourage Level III and Level IV NICET certified personnel to become team leaders. However, we must be careful that rating calculations and stress analyses activities should still be kept under the supervision of a professional, experienced bridge engineer. In our normal procedures, the field team leader and the bridge rater-designer work very closely and are quite often the same individual.

In general, we commend you on tackling this difficult subject of improving Bridge Inspections and Evaluations by offering periodic Revisions to reflect the changing parameters and refinements in the State of the Art. Your presentation of this docket was prepared in a clear, concise and fourthright manner, and we hope that our constructive comments will help you to achieve your goals.

Very truly yours,

A.G. LICHTENSTEIN & ASSOCIATES, INC.

A.G. Lichtenstein, P.E., Dr. Eng.

OVERVIEW OF FIRM

A. G. LICHTENSTEIN & ASSOCIATES, INC. is a Consulting Engineering firm with corporate headquarters in Fair Lawn, New Jersey, and offices in New York City, New York; Langhorne, Pennsylvania; Framingham, Massachusetts; and Watertown, Connecticut. Abba G. Lichtenstein, P.E., Dr. Eng. founded the firm in 1963 with the intent of specializing in bridges.

Over the years the firm has expanded to presently contain a diverse bridge and highway oriented technical staff of over one hundred thirty employees including over thirty licensed Professional Engineers. The Company has demonstrated expertise in bridge engineering, specializing in inspection, rating, rehabilitation and design of highway, railroad, fixed and movable structures on a nationwide basis. Our projects have included over 4,000 bridges with Authorities, County, Municipal and local transportation agencies.

AGLAS' specialization in bridges covers the related engineering fields of railroads, highways, hydraulics, soils, survey and construction supervision. In this way we are able to serve our clients efficiently and economically without engaging subcontractors. Our personnel have substantial experience in computer design and analysis of bridges, highways, dams, and hydraulic structures. The firm uses the most sophisticated computer programs required for each specific assignment. Effective project control and financial management control systems are performed on our in-house computer.

Our technical staff is headed by a strong management team of experienced engineers carefully supervising each step of every project. A.G. Lichtenstein, P.E., Dr. Eng., and the three Principals of the firm, Joseph J. Pullaro, P.E.; Charles M. Minervino, P.E.; and David M. Moskowitz, P.E.; head the management and engineering staff. This arrangement results in the daily operation of the firm being planned and administered by the experienced engineers in direct control of the projects. The Principals are supported by six Senior Associates/Project Managers: Michael A. Nathan, P.E; Thomas J. Clancy, P.E.; E. Allen Randall, P.E.; Leonard Markowski, P.E.; William A. Easterbrook, Jr., L.S.; and Richard C. Kreppel, P.E.; all with a minimum of thirteen years experience. Richard Slattery, P.E. and Paul Blair, P.E. are Associates in the firm and complete the engineering management team.

New Bridge Design

AGLAS' experience over the years includes the design of numerous bridges of all types and sizes in steel, including curved girders, reinforced concrete, and prestressed concrete. These structures have been designed as multiple simple span bridges, continuous spans, and single span structures with a variety of substructure elements and foundation conditions. Bridge designs, roadway/railroad geometrics, and hydraulic modeling are all performed on our in-house computer. In the course of these designs, we have prepared the related surveys, hydraulic reports, permit applications, roadway/railroad designs, soils evaluation, and agency coordination as needed.

Our design staff concentrates on progressing a project through the design phases including processing for approvals by the Federal and State Regulatory Agencies having jurisdiction over the Region. We have extensive experience with U.S. Coast Guard and U.S. Army Corps of Engineers, and we serve as Consultants to these Agencies on special projects.

Our engineering staff is separated into a number of specialized areas so that each step of a project is handled by experienced designers, all coordinated by the Project Engineer, as follows:

- Bridge Design
- Highway/Railroad Design
- Hydraulics
- Survey/ROW
- Permits (including Environmental)
- Utilities
- Soils

In this manner our designs can be progressed efficiently and economically with the emphasis placed on those aspects of the Project requiring special attention.

Movable Bridges

AGLAS experience over the years includes the design and rehabilitation of a number of movable bridges on both highway and railway systems. A major portion of these movable bridge assignments involve the preparation of bid documents for the rehabilitation and/or replacement of single and double leaf bascule bridges, including design of mechanical and electrical systems. AGLAS has formidable expertise in the design of bridge protective devices, i.e., navigational controls and fender systems. The attention given by our firm to the permit process, as described above, is especially applicable to the design of movable bridges.

Inspection and Rating

AGLAS specializes in the in-depth inspection, rating and rehabilitation of bridges. On these assignments we can provide our own rigging and climbing and other field services using in-house engineers. Through the use of our own experienced engineers, we are able to offer our clients the following services:

* Rigging and climbing of complex and difficult access bridges by experienced Bridge Engineers.

* Tactile, hands-on inspection of hidden members and connections.

* Complete Deck Evaluation Surveys to FHWA Standards, including

chloride samplings, delamination survey, and equipotential testing.

- Obtaining steel coupons and concrete core samples from existing bridges for laboratory testing.
- Operation of rented personnel lift equipment.
- Evaulation of mechanical and electrical systems of movable bridges.
- Field evaluation of fatigue sensitive welded details.
- Field testing, including ultrasonic and eddy current testing, dye penetrants, and strain gage load testing programs.
- Fathometric and topographic surveys.

Our staff is kept informed of the latest AREA, AASHTO and FHWA bridge inspection and rating requirements, as implemented by the various State Departments of Transportation. Dr. Lichtenstein has been instrumental in the development of national bridge inspection standards, and has taught short courses and seminars on bridge inspection, rating and rehabilitation at various Universities throughout the United States, including: George Washington University; Cornell; University of Missouri-Rolla, Pennsylvania, Wisconsin, Rutgers and Hofstra. His international teaching experience includes the Peoples Republic of China in 1983 and Scotland in 1983. In addition, Dr. Lichtenstein has trained bridge inspection crews for county governments in New York, New Jersey, and has conducted Seminars on the State-of-the-Art Procedures of Bridge Inspection and Rating for Bridge Engineers employed by NYSDOT, Port Authority of NYNJ, Ohio DOT, Illinois DOT, PA DOT, the New York Thruway Authority, Tennessee DOT, Long Island Railroad and Canadian National Railways.

Repair/Rehabilitation of Bridges

Our company is proud of its reputation as "problem solvers". Over the years, AGLAS has been called upon to provide design services on numerous inspection/repair/rehabilitation projects, many on an emergency basis. These assignments generally involved: identifying a problem in the field; inspecting the conditions; evaluating the need for repair/rehabilitation; recommending methods of repair; preparing designs and contract plans, specifications and estimates; providing construction support services as needed. The timely response to these requests is given priority in our scheduling. Projects of this type have included the design of:

- Repair/replacement of damaged or deteriorated truss members.
- Steel repair of heavily rusted beams and girders.
- Retrofitting of failed, bolted, riveted or welded connections.

- Repair/Rehabilitation of Cable Hangers and Anchorages.
- Temporary shoring of trusses or girders and replacement of bearings.
- Repair of severely spalled reinforced concrete abutments, piers and retaining walls.
- Repair/rehabilitation of bridge decks.
- Repair/replacement of deteriorated or damaged timber piling, fender systems, bulkheads, etc.
- Slings for pin/hanger assemblies on bridges.

Our staff is experienced in the latest methods of evaluation of conditions and the design of repairs and rehabilitation of structures and has developed innovative design techniques for rehabilitation on several major steel bridge projects, expecially trusses. Our engineers are trained to recognize potentially dangerous conditions, evaluate the severity of the problem, and advise our clients on the need for emergency actions.

Computer Capabilities

All of our offices use PC based Engineering and Word Processing Systems. Our Bridge Analysis Software includes PIER, PRESTR, BOXLFD, and STAADIII, as well as various programs written in-house for arches, frames, and trusses. Bridge Rating Capabilities include BAR5 and in-house prestressed Beam Rating Program. Survey Data is downloaded directly from our TOPCON instruments to the PC and processed with the Pro-consol Ltd. COGO package. INGO is used to determine Bridge Geometry and Lotus 1-2-3 is used for Engineer's Estimates, and various administrative tasks. We can communicate with each office using Hayes SMARTMODEM 1200B and Hayes SMARTCOM II Software. We utilize time sharing services via a Main Frame, when necessary.

Availability

We are available to assign an experienced professional staff to this Assignment, headed by engineers thoroughly experienced in current AREA, AASHTO, FHWA, and State Standards, policies, etc. AGLAS has demonstrated ability to complete assignments efficiently, economically and on schedule.

Mr. **Oberstar**. The subcommittee will continue its inquiry into this matter of bridge inspection and bridge safety. As the hearing indicated repeatedly from witnesses, the aging inventory of bridges, the increasing questions about deficiencies of the deck and superstructure, the increasing loads to which bridges are subjected from higher frequency and heavier loads of truck traffic will only intensify in the years ahead. This committee and the Federal Highway Administration and State and local Governments must maintain their vigilance. We shall certainly make that a very high objective of this subcommittee.

Does the gentleman from Pennsylvania have any closing comments?

Mr. **Clinger**. No, Mr. Chairman. Thank you.

Mr. **Oberstar**. I want to thank you, Mr. Clinger, and our staff for the splendid work that they've done in very long preparation for this most important hearing.

The subcommittee stands adjourned.

[Whereupon, at 2:24 p.m., the subcommittee was adjourned.]

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